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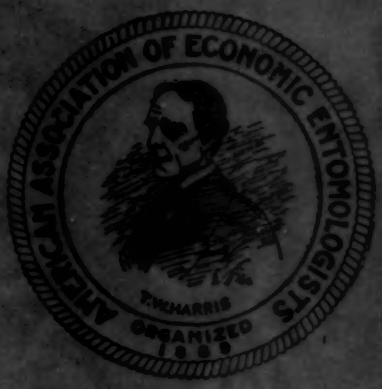

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JOURNAL
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VOL. 22 JUNE, 1929 No. 3

Proceedings of the Forty-first Annual Meeting of the American Association of Economic Entomologists, Section of Plant Quarantine and Inspection

Thursday Morning Session, December 27, 1928

The Section of Plant Quarantine and Inspection of the American Association of Economic Entomologists was called to order at ten o'clock by the Chairman, L. S. McLaine.

CHAIRMAN MCLAINE: The first business before the session is the appointment of committees. On the Committee on Nominations, I beg to appoint: R. W. Harned, E. R. Sasscer, E. N. Cory. On the Resolutions Committee: W. C. O'Kane, Richard Faxon, F. N. Wallace.

The first paper on the program is an address by the Chairman of the Section.

THE BASIS AND AIMS OF PLANT LEGISLATION

L. S. MCLAINE, *Entomological Branch, Ottawa, Canada*

ABSTRACT

While entomological training is necessary for those connected with plant legislation, a knowledge of commerce, economics and transportation is essential for the successful operation of any regulation other than a straight embargo. All regulations should be framed with a scientific background. One solution of the difficulties connected with plant legislation is the establishment of adequate inspection services in all countries, so that all commodities exported may be accompanied by a clean bill of health of real value. A brief review is given of the recently reorganized Canadian service, dealing with both import and export shipments of plants and plant products.

Before proceeding with my paper, I should like to take this opportunity of expressing my appreciation of the honour that you have conferred by electing me chairman of this Section. As has so frequently been said, insects do not regard international boundaries and from the constant migration of entomologists that takes place between Canada

and the United States it would appear as if they too might be included in this same category. When, therefore, you select an officer from "across the line," it may be regarded as a welcome and invitation to join the happy fold of horticultural inspectors. This can only result in a better understanding of the difficulties which both Canada and the United States have to face, for after all, the problems of plant quarantines and regulatory enforcement in both countries, are, for the most part, very similar.

In a recent address before the Entomological Society of Ontario, Dr. A. C. Baker, of the Bureau of Entomology, very ably presented the difficulties that entomologists were faced with today and pointed out the fact that they had to be practically "jacks of all trades". There was one very significant point in connection with this paper, however, which will be of great interest to those of us who are engaged in plant quarantine and horticultural inspection work, namely, that no attempt was made to classify or discuss the status of those engaged in the moulding and application of insect pest legislation. In fact it seemed as if we should be excluded from the entomological field entirely, and placed "outside the pale", as he apparently considers that we should not be included among the scientific investigators. Whether we may or may not concur with Dr. Baker in this connection is an open question. Nevertheless, there is but little doubt that all those who are engaged in this type of work will readily agree that the formulation and preparation of regulations and quarantines involve so many complications that we wonder at times whether it will be feasible to administer them after they have been enacted. The almost unlimited number of insect and pest regulations in force throughout the civilized countries of the world causes us to pause and think as to where it will all end; are we building a tower of Babel?

An entomological background and training is undoubtedly necessary for those of us who are connected with pest legislation, but the training by no means should stop there. Commerce, economics and transportation play no mean part in this field and are of vital importance to the successful operation of any regulation other than a straight embargo. In connection with the latter, economics play an all-important part; goods can only be paid for in kind, and the mere accumulation of gold will not further the interests of any country in external trade. Another point to be considered is that in times of urgent necessity in any country will embargoes or regulations hold for commodities classed as other than luxuries or of minor importance? What would happen with such

necessities as rice or wheat? This question of embargoes has been ably discussed in a paper presented before the Pan-Pacific Science Congress (1923) by J. C. F. Fryer of England.

In this day of trade rivalry which is, I believe, keener than ever before in the history of the world, those who are engaged in questions relating to legislation of this type may be in danger of being called upon to frame policies of a regulatory nature for trade or political purposes. To offset this danger, there is only one defense and that is that all regulations must be framed with a scientific background, and on a basis that will withstand the attacks of scientific men other than those particularly interested in the problem under consideration.

One solution of these difficulties is the establishment in all countries of an adequate inspection service in charge of administrators with this scientific background and with a personnel of the highest type, thoroughly trained for their work. The necessity for this has been emphasized time and time again. Arthur Gibson in his presidential address before this Association (1926) referred to this question in connection with the future development of international entomology, and pointed out the responsibility that rested upon the shoulders of those actually engaged in the work and the necessity of securing better trained men. The International Phytopathological Congresses have endeavoured also to bring it about, although progress has been severely handicapped owing to the diversity of opinion of the delegates. Nevertheless, great progress has already been made and undoubtedly will continue to be made in the future. When all exporting countries can be brought to realize that only commodities with a clean bill of health may be shipped, and that commodities which can not be covered by such a certificate will have to be used domestically or processed in such a manner as to eliminate danger to the importing country, if and when this is accomplished, the members of this section can safely retire to Elysium.

The above remarks have been for the most part in the abstract; let us now turn to the concrete, and consider a commodity which is perhaps of the greatest interest to us all, that is, nursery stock. By "nursery stock", is meant all living plants or portions of plants for propagation, ornamentation or cropping. For all engaged in horticultural inspection work have had trouble with this commodity, and the ever present question is, what is to be done about it? In reviewing various addresses and papers presented before this section it will be noted that the authors all have the same objects in view, namely, a uniformity of inspection laws and the shipping of clean stock. The former is gradually being

accomplished in the United States at least, by the establishment of a National Plant Board, and Regional Plant Boards which may be used as clearing houses for ironing out difficulties in these matters. In regard to the latter point, namely the inspection of stock, Headlee as chairman of this section in 1912, brought out the necessity of having certificates mean what they say; Haseman in 1922, urged the necessity of inspecting stock at time of digging; and many others brought out different points, but all with the same object in view, that is the shipping of clean stock. Your chairman last year (J. H. Montgomery) summarized the question and offered a solution of the difficulties, which if followed will, I believe, do much to alleviate the present situation which affects us all. He said, "The nearest approach, in my judgment, to an adequate service would be represented by a combination of those methods:

"(A) Field inspection at frequent intervals, the frequency depending on climatic and cultural conditions.

"(B) Point of origin, i.e., packing house inspection.

"(C) Point of destination, i.e., terminal inspection."

It is fully realized that no inspection of commercial shipments carried on during the "rush" seasons can guarantee absolute freedom from all insect pests, but if the above system is followed out it will undoubtedly improve the general situation. Furthermore, inspectors should endeavor to prevent the shipping out of stock about which there is any doubt.

I trust that a personal reference as to what we are trying to do in this regard in Canada, will be excused on the grounds that it may be of some interest. The import and export inspection service is in the hands of the federal authorities, with provincial co-operation, especially in the case of British Columbia. With regard to export shipments, the field inspection of nurseries during the growing season is carried out by the provincial authorities, and the inspection at time of packing is done by federal officers (except in British Columbia). In the case of large shipments the inspector, visits and inspects the stock on the premises of the grower; small shipments, on the other hand, must be routed via an inspection port for examination. An attempt is being made to maintain a high standard of efficiency with export shipments. Inspectors will not certify any stock visibly affected by pests or diseases.

With regard to the import service, a radical change was made on September first last. All countries including the United States, are now placed on the same basis. We are now asking for the same service, treatment and consideration, which we have been endeavouring to give to others, namely that due precautions be taken to ship us only clean stock. The present regulation may be briefly summarized as follows.

Nursery stock imported into Canada must be accompanied by a certificate of inspection issued at time of packing. Shipments are required to enter Canada through one of the inspection stations, where the stock is either examined or permitted to proceed to destination for inspection. Inspection stations have been established at various points adjacent to the international boundary, from Halifax to Vancouver. These stations are open throughout the year. Mail shipments are also subject to inspection and are examined at the inspection station nearest to the ultimate destination of the package; special labels are issued to cover such importations. The clause in the previous regulations, requiring the fumigation of certain classes of stock previous to shipping and originating in the United States has been rescinded. The successful operation of this regulation will depend not only on our own service but on the co-operation of others.

Our system in Canada has not yet reached that state of perfection which we consider so desirable but our ideals are high. We believe that the importer, wherever he may be, should receive only stock as clean as it is possible to give him. That is the reason, for my very great interest in the development and improvement of inspection services in all countries, for by such means we have the opportunity of protecting the agricultural and horticultural industries which are of great concern to us all, for they, after all, are the basic industries of the world, and upon them depends the maintenance of civilization.

DR. C. L. MARLATT. I arise not to discuss the paper, the paper speaks for itself, but to express the hearty appreciation which we all feel in the United States for the cooperation and sympathetic consideration which we have always had from our neighbor across the line to the north of us. We are very glad to cooperate with Canada as she has cooperated with us and try to meet conditions which she has laid down in her recent quarantine action, conditions which we certainly approve and deem to be absolutely just and proper. I was very much interested in listening to this paper.

DR. T. J. HEADLEE: Mr. Chairman, in listening to this paper, it occurred to me that the question of how inspections are to be made officially and how nursery goods and parts of nursery goods not susceptible to inspection can be certified as being clean needed stressing. There is probably only one way in which such a situation, such a need, can be cleared up, and that is through research. Some of us feel that while there may not be too much money being expended in law enforcement, there is certainly too little money being expended in research as the

basis for this law enforcement procedure. It might not be a mistake for this group to go on record as favoring more liberal support of investigations which form the basis for the inspection and certification work.

MR. ARTHUR GIBSON: I was very glad indeed to hear what Mr. McLaine said in his paper for the necessity of placing all such quarantine work on a sound scientific basis. I was also glad to hear what Dr. Headlee said in support of that statement. I personally agree with these remarks. I would suggest that Dr. Headlee's suggestion be referred to the Resolutions Committee. I think, personally, that that group should certainly take some action on that aspect of the subject.

The motion was seconded by Dr. Marlatt; and was then put to a vote and carried.

CHAIRMAN MCLAINE: I am sorry we haven't a representative of the National Plant Board on hand this morning, so that their report will have to be postponed.

We now come to the reports of the Regional Boards. I will call on Dr. Headlee for the report of the Eastern Plant Board.

EASTERN PLANT BOARD

THOMAS J. HEADLEE, Ph.D., *President, Eastern Plant Board*

Article II of the Constitution of the Eastern Plant Board sets forth that "the business of this board shall be the promotion of the efficiency of plant pest control, with due regard to the agricultural, industrial and urban business interests of the territory covered by its operation."

Lack of uniformity governing the entry of nursery stock into each of the various states has until recently formed the most serious interference with honest conduct of the nursery business that the nursery industry has experienced at the hands of plant pest law enforcement organizations. Back of this lack of uniformity lies a difference in evaluating the importance of different species of economic insects and plant diseases on the part of the law enforcement organizations concerned. Consequently any real effort looking toward the promotion of uniformity must begin with an attempt on the part of the plant pest law enforcement organization to reach an agreement upon the economic status of the plant parasites characteristic of the territory covered.

While many of the nurseries within any limited portion of the United States would like to ship stock more or less all over the United States and consquently need uniform regulations throughout the country, it is obvious that the movement toward uniformity must start along fundamental lines at some place and with some organization.

Accordingly the Eastern Plant Board early in its history appointed a plant pest committee whose business it was to secure the ideas of its thirteen states concerning the economic importance of each species of injurious insect and plant disease regarded as of economic importance within the boundaries of the said thirteen states. It cannot be said that this committee has even yet completed its work but the delay

seems to be due partly to a lack of definiteness in the minds of the said law enforcement organizations and partly due to inactivity on the part of the committee.

The writer strongly thinks that this movement should be pushed to its logical conclusion and that the same type of movement should be thoughtfully and carefully carried out in each of the other three plant boards.

With this data in hand it should be possible to strike out regions in the United States where certain insects and plant diseases are considered of economic importance and where others are not. Certification of shipment into each of these regions should then be made to provide definite assurance that the stock covered is free from the particular pests considered of economic importance in the said region. It may seem that this scheme would involve multiplication of certificate forms and of inspection or treatment lying behind these forms. Without any doubt the number of state nursery certificate forms would be increased and without any doubt in some instances the amount of inspection or treatment lying behind them would be increased but uniformity of procedure would be secured and efficiency would be increased.

Within recent years there has appeared a tendency on the part of state plant pest law enforcement organizations to attempt protection of the territory covered by their responsibility from plant parasites presumably carried by incoming nursery shipments and to that end have employed onerous and costly requirements from the standpoint of both the plant pest law enforcement organizations and the nursery industry. The writer has been told by some members of plant pest law enforcement organizations, whose efforts in this field have been prominent, that the interest of said organization in incoming nursery stock is very great while their interest in outgoing nursery stock shipments is of a rather minor character.

Also within recent years the activities of the Federal Horticultural Board concerning insect and plant disease new to, and not heretofore widely distributed within the United States has become increasingly prominent and many drastic quarantines have been laid and an attempt made to enforce them.

The consequence is that nursery shipments frequently carry more than one tag and if the present rate of increase is continued they may very well have to carry many tags in order to satisfy state and federal law enforcement organizations. In fact the complexity of requirements in this matter have already reached a point where the nursery industry is feeling acutely the edge of these activities. Presumably, of course, the benefits to American agriculture far outweigh the losses occasioned by this interference with the conduct of business but the writer is of the opinion that it may be exceedingly difficult to prove that such is the case.

The business of the Eastern Plant Board is to promote "efficiency of plant pest control, with due regard to the agricultural, industrial and urban business interests of the territory covered by its operation." It is consequently working for increased efficiency in plant pest control and decreased interference with legitimate business through the seeking of a common basis of understanding on the economic importance of plant parasites, first within its own territory and then within the territories of the other plant boards.

CHAIRMAN MCLAINE: The next is the report of the Southern Plant Board. I will call on Professor Harned.

REPORT OF THE SOUTHERN PLANT BOARD

By R. W. HARNED, *A. & M. College, Miss.*

Instead of holding the regular annual meeting of the Southern Plant Board last year, the executive committee requested the members to attend the meeting of the Section of Plant Quarantine and Inspection of the American Association of Economic Entomologists that met in Nashville, Tennessee on December 27, 1927. At the close of that meeting a short business session of the Southern Plant Board was held at which the old officers were reelected as follows:

R. W. Harned, A. & M. College, Miss., Chairman
W. E. Anderson, Baton Rouge, La., Vice-Chairman
B. P. Livingston, Montgomery, Ala., Secretary
Wilmon Newell, Gainesville, Florida, Representative on National Plant Board for two-year term, 1928–29.
R. E. McDonald, Austin, Texas, Representative on the National Plant Board for one year term, 1928.

At the request of our members from six states the Chairman called a special meeting of the Southern Plant Board at Memphis, Tennessee on March 30, 1928. Commissioner of Agriculture, Harry D. Wilson of Louisiana, sent out a similar call to the southern Commissioners of Agriculture and all others interested in the pink bollworm situation to meet at the same time. Commissioner Wilson acted as Chairman of this meeting. Every important cotton growing state was represented except North and South Carolina. Quarantine officials from all states in the Southern Plant Board except those two states, were present. Three representatives of the Western Plant Quarantine Board, Lee A. Strong of California, State Entomologist, Oscar C. Bartlett of Arizona, and President H. L. Kent of the New Mexico State College of Agriculture, and three representatives from the United States Department of Agriculture, J. E. Graf, B. R. Coad, and G. G. Becker, took prominent parts in the discussions. After a rather full discussion of the pink bollworm situation by all of these men and by R. E. McDonald and others from Texas, a committee on resolutions was appointed that prepared resolutions that were unanimously adopted at an afternoon meeting as follows:

RESOLUTION NO. 1

Resolved, That this conference representing the agricultural, commercial and industrial interests of the Cotton Belt with representatives present from practically all the cotton growing states from the Atlantic to the Pacific hereby declare our conviction that the protection of the cotton producing and manufacturing industries of the United States demand the adoption of a general policy of the complete eradication of the Pink Boll Worm from all infested areas of the United States and ultimately from the entire North American continent.

Resolved, That, it is our conviction that the only effective policy for eradication of the Pink Boll Worm will be based upon the establishment of non-cotton zones with compensation to growers and with such supplementary regulatory measures as previous experience has proven to be necessary. This policy will accomplish the protection of the entire cotton industry of the United States and therefore, should be based upon adequate Federal appropriations.

Resolved, That, as an initial step toward the accomplishment of this desired complete eradication of the Pink Boll Worm, we endorse and urgently request that Congress pass immediately the joint resolution, H. J. Res. 237, providing for the eradication of the Pink Boll Worm, and urgently request an appropriation therefor, which contemplates full Federal compensation to growers; and furthermore, hereby declare our conviction that an initial appropriation of at least five million dollars ($5,000,000.00) is absolutely necessary to carry on this work.

RESOLUTION NO. 2

Adopted by Conference including sixty representatives of cotton growers and commercial and industrial interests throughout, the cotton belt together with State Commissioners of Agriculture, Entomologists and Quarantine Officials in meeting at Memphis, Tenn., March 30th, 1928.

TO THE HONORABLE SECRETARY OF AGRICULTURE AND THE SECRETARY OF STATE, WASHINGTON, D. C.

WHEREAS The Pink Boll Worm of cotton has repeatedly invaded the United States from Mexican sources of infestation and measures are now being taken to accomplish the eradication of this exceedingly dangerous pest thruout the infested areas within the United States, and

WHEREAS Permanent and complete protection to cotton production on the North American continent cannot be obtained as long as infestations are allowed to continue in Mexico.

Therefore be it Resolved, That this conference earnestly request the Secretary of State and the Secretary of Agriculture, or other proper officials representing the United States Government to initiate and expedite such negotiations with the Mexican officials as may be necessary to arrange for effective cooperation in eradication of this pest in Mexican territory.

(Signed) W. E. HINDS, *Chairman*

This conference also voted to send Dr. W. E. Hinds to Washington to appear before committees in Congress to urge the adoption of the Buchanan resolution authorizing $5,000,000 for pink bollworm eradication in the United States.

At the close of the pink bollworm conference a short special meeting of the Southern Plant Board was held, during which cotton seed quarantines and permits were discussed.

The next meeting of the Southern Plant Board will probably be held at Houston, Texas, February 6 and 7, 1929 at approximately the same time as the Cotton States Branch of the American Association of Economic Entomologists and the Association of Southern Agricultural Workers hold their annual meetings.

CHAIRMAN MCLAINE: We next have the report of the Central Plant Board, Mr. Wallace.

REPORT OF THE CENTRAL PLANT BOARD

By F. N. WALLACE, *Indianapolis, Ind.*

The Central Plant Board held its Fourth Annual meeting at St. Louis on March 2nd and 3rd, 1928. Illinois, Iowa, Kansas, Minnesota, Missouri, Ohio, Wisconsin and Indiana were officially represented. Nebraska was represented but not by official representatives. Four States, Kentucky, Michigan, North Dakota and South Dakota were not represented.

The Board took up the report of the National Committee on the preparation of a statement of the principles of quarantines. This statement was prepared by Dr. W. A. McCubbin and received very favorable comment. The action of the Central Board on the statement of principles was deferred until the next annual meeting. Members of the Board were requested to send to Dr. McCubbin any suggestions which they might wish to make.

The Ralston Purina Company of Kansas City requested permission of the Board to bring alfalfa hay to Kansas City from the area quarantined for alfalfa weevil so that the alfalfa might be ground into meal at Kansas City. The Ralston Purina

people presented their case very fairly but the Board voted 8 to 1 not to permit the alfalfa to be brought into Kansas City without treatment.

The committee on raspberry regulations brought in their report signed by three of the four members of the committee, who were present, in favor of new regulations governing the certification of raspberry plants; the main requirements consist of double inspection of raspberry plants.

The members of the Central Board decided to change their constitution and combine the office of Secretary and Treasurer. They also made the annual dues for membership in the Plant Board $15.00 for each State having membership, but provided that these dues should not apply to any State that could not legally pay such dues. Another section provided that the money shall be appropriated to the National Plant Board at the discretion of the officers of the Central Plant Board.

The committee on regulations for the interstate movement of nursery stock presented their report.

There are in force three types of requirements for the shipment of nursery stock in the United States; namely, terminal inspection, certificate of inspection by the State of origin and the permit type. Fortunately, in the Central States group the certificate of State of origin type is the one in general use and the members of the Central Board feels that that is the one most applicable to their requirements.

There has been considerable difference in the Central States as to what constitutes nursery stock. The Central Plant Board adopted the following definition of nursery stock:

1. The term "nursery stock" shall be considered to include all woody and herbaceous biennials or perennial plants, and parts thereof, except the seeds, for, or capable of, propagation, or capable of carrying injurious pests.
2. Greenhouse plants may be exempt from the inspection requirement.
3. Growers of greenhouse plants who wish to make shipments into states requiring that an inspection certificate accompany such plants may have an inspection. by making application for the same.
4. Greenhouse certificates shall not be valid for longer than six months.

This was adopted unanimously by those present. The committee presented a list of injurious insect pests and diseases with recommendations for the absolute embargo for some and recommendations for control of others. This list is too long to present to the National Plant Board but the list and recommendations were unanimously adopted for the guidance of the members of the Central Board and the Secretary of the Central Board was directed to send a copy of this uniform plan to the Secretary of each of the regional boards.

A motion was unanimously adopted that an effort be made to induce States, which require fumigation as a condition of entry of nursery stock to rescind the fumigation requirement.

The following officers were elected for one year:

President, Frank N. Wallace
Secretary-Treasurer, P. A. Glenn
For member of the National Plant Board for two years, A. G. Ruggles
For member of the National Plant Board for three years, George A. Dean

CHAIRMAN MCLAINE: The secretary of the Western Plant Quarantine Board has sent his paper and it will be published in the proceedings of this session.

WESTERN PLANT QUARANTINE BOARD

By W. C. JACOBSEN, *Sacramento, Calif.*

The 10th Annual Conference of the Western Plant Quarantine Board was held at Salem, Oregon, during July, 1928—postponed a month from the regular time. In spite of this postponement eleven out of fourteen possible representatives attended what was one of the best meetings the Board has ever had. The only representatives missing were those of Montana, Wyoming, and Lower California. In place of Lower California, however, there were two representatives from the Republic of Mexico.

Governor I. L. Patterson of Oregon addressed the group on two occasions and showed a very decided familiarity with the importance of plant quarantine work.

The reports of the several representatives noted outstanding pests for the past year and advised specifically concerning those which might be considered dangerous to the other states. Perhaps the most outstanding of those mentioned were Psyllid Yellows affecting potates and tomatoes in Utah, termites in Hawaii, and the rice stem borer recently introduced into Hawaii.

The standing committees of the Board on Treatments, Apiary Inspection, and Pest Surveys presented reports such as would indicate that these committees are very active. They were further augmented by the appointment of a committee under the chairmanship of the retiring president, Schweis of Nevada, for simplification of plant quarantine schedules in cooperation with the transportation agencies. The Western Plant Quarantine Transportation Committee has been represented at each meeting of the Board. One of its primary functions was to so coordinate their activities with the Board that a schedule of the plant quarantine regulations in effect could be issued in an appreciably simplified language for the aid of express and rail agents. It appears that this is now capable of proper accomplishment.

The sound development of plant quarantine work in the United States as a result of the formation of four regional plant boards and the National Plant Board was outlined by Mr. Lee A. Strong, Assistant Director of the California State Department of Agriculture. The correlation of the interests of the regional boards into a National Plant Board, thereby coordinating the plant quarantine work for all of the states with that of the federal government, was noted both in historical survey to indicate the accomplishments already made and the future possibilities of the National Plant Board in formulating better plant quarantine results. The contribution to sane and uniform plant quarantine enforcement by the regional boards and the National Plant Board was exemplified as being highly valuable in matters of emergency, as well as in rational advisory work for routine progress in regulatory work.

The various states and especially certain bureaus of the U. S. Department of Agriculture were asked by resolution to compile and tabulate all information now available pertaining to the treatment of plants and plant products which are the subject of quarantine restrictions. This summary to be a first step in aiding determinations of whether to eliminate certain embargoes or to modify restrictions if and when full safeguard can be obtained by subjecting certain commodities to treatment. Intensive investigations of methods are undoubtedly necessary but should be undertaken only after methods now known are tabulated.

The Mexican Department of Agriculture, through its two representatives, indicated the rapid development of pest preventative work in that Republic and credited the association with Western Plant Quarantine Board as being in no small measure

responsible for the advances made. It was requested that an international pest commission be created between the United States and Mexico to make detailed studies of insect pests and plant diseases with a view to harmonizing the plant quarantine relationships between the two countries but keeping in mind the importance of adequate safeguards at all times. The National Plant Board was requested to initiate such a commission in the event that other official agencies were unable to do so.

Evidence was submitted indicating that there is need for expansion and tightening up of the inspection work carried on by the U. S. Plant Quarantine and Control Administration at the border points between the United States and Mexico, especially to prevent the recurrence of pest entrance such as has been instanced in the case of the pink bollworm of cotton and the Mexican fruit fly. Improvement was suggested for the interstate vehicular inspection stations aimed to prevent spread of pink bollworm of cotton.

The importance of air transportation in quarantine enforcement was stressed and it became evident that plant quarantine enforcement officials should soon have to give greater heed to the inspection of commodities which may be transported by airplane.

Apiary inspection was given its place in the affairs of the Board, especially since recent development in the suppression of American foul brood and the prevention of its spread interstate have gained prominence within the last few years. It was recommended that uniform apiary legislation be considered by all states not now having adequate enforcement authority and that uniform quarantines be adopted to prevent the spread of this infection.

The Western Plant Quarantine Board requested the Secretary of Agriculture to place fruit and rose nursery stocks under such restrictions as would eliminate them from continuing to be a menace as pest carriers from foreign countries. This request is a repetition of one submitted at each of our recent meetings and continues to be more necessary with each year's additional information as to the pests introduced in these stocks.

The Plant Quarantine and Control Administration was requested to take such steps as were possible to eliminate the risk attending the introduction of rice pests, particularly the rice stem borer, through straw packing accompanying shipments from the Orient. A recent introduction of a serious rice pest into Hawaii was the occasion for this consideration.

It was brought out that there is greater need for sympathetic understanding by the courts of the land of the needs of quarantine officers in their enforcement work and subsequent prosecutions. It is discouraging to enforcement officers to make arrests and submit an apparently well founded case only to have the case lost because of lack of interest in the seriousness of the violations. This is true for both State and Federal Courts. Frequently the precedent of the law of the courts gives rise to conflicts where biological laws are involved. Biological law such as appears in the case of pest spread is not allowed just consideration if it disagrees with the precedent of court law.

Turning to the next paper on the program, I may say that, as you all know, it is unnecessary to give any formal introduction to Dr. Marlatt, who is so well known to us all. I have much pleasure in calling on Dr. Marlatt.

RECENT DEVELOPMENTS IN FEDERAL PLANT QUARANTINE ACTIVITIES

By C. L. MARLATT, *Washington, D. C.*

ABSTRACT

The Plant Quarantine and Control Administration has recently been organized to take over all the plant quarantine and control work formerly carried out by the Federal Horticultural Board, the Bureau of Entomology, and the Bureau of Plant Industry. Among the important developments of the year have been a discontinuance of the admission of certain fruit stocks, the spread of the pink bollworm of cotton, the remarkable success of the Mexican fruit worm quarantine and eradication work, and a reorganization of the date scale project.

On the recommendation of the Secretary of Agriculture, the plant quarantine and control work of the federal department heretofore divided among three separate organizations; namely, the Bureau of Entomology, the Bureau of Plant Industry, and the Federal Horticultural Board; has been centralized, effective July 1, in a new unit to be known as the Plant Quarantine and Control Administration.

This reorganization has resulted in less actual change in personnel and responsibility than might be imagined. In their work in quarantine administration, the Bureaus of Entomology and Plant Industry have always acted as agents of the Federal Horticultural Board, and the Board has been responsible for the preparation of the quarantine regulations and the approval of treatments and methods of inspection. It has not, however, had responsibility for the fiscal and personnel details connected with any of the larger quarantine operations except those relating to the pink bollworm, the Thurberia weevil and the date scale. The Bureau employees heretofore engaged in such projects as European corn borer control and the prevention of spread of the gipsy moth and Japanese beetle have, in large part, been transferred to the new Administration without change of assignment and are carrying out the work as heretofore.

The total appropriations to the Plant Quarantine and Control Administration for the current fiscal year amount to $2,971,050, carried in the regular agricultural appropriation act, in addition to certain unexpended balances from appropriations for the pink bollworm and date scale, carried in the deficiency bills for the previous season. These amounts do not include an appropriation of $5,000,000 for the establishment of non-cotton zones in the pink bollworm infested area (an amount which for various reasons has not been available for use), nor an authorization for an appropriation of $7,000,000 for the European corn borer whichwas not followed by the enactment of an appropriation bill itself.

There has naturally resulted from this material increase in field work an enlargement in the overhead organization in Washington. The personnel will be given in full, for the information of those interested, in the next issue of the Service and Regulatory Announcements. This latter series of publications, like the mimeographed series formerly known as HB, is being continued uninterrupted and the same system of numbering will be retained.

In addition to making the administration of regulatory duties more centralized and efficient, the transfer has been of material benefit to the Bureau of Entomology also. In fact, an important reason for the reorganization was the objectionable piling up of regulatory duties in that Bureau, and it is expected that the change will release the personnel for research work and will enable the heads of the various offices in the Bureau to devote their attention to the organization of research activities instead of having their time taken up with the administration of large regulatory and control projects.

An important development of the year was the adoption of the so-called search and seizure amendment to the plant quarantine act effective May 1, 1928. This amendment gives authority, hitherto lacking, to stop and—without warrant—to inspect, search, and examine persons, vehicles, receptacles, boats, ships, or vessels, and to seize and destroy or otherwise dispose of plants and plant products or other articles found to be moving or to have moved in interstate commerce or to have been brought into the United States in violation of the act or of any quarantine order thereunder. The need for such amendment has been felt throughout the whole period of enforcement of the plant quarantine act and has become especially imperative in connection with the enforcement of such domestic quarantines as those on account of the European corn borer, the Japanese beetle, the pink bollworm, and the white pine blister rust. Ninety-nine per cent of the people who pass quarantine lines are perfectly willing to stop and have their cars examined to determine whether material is being carried which might transport such pests as pink bollworms, European corn borers, or Japanese beetles. An exceptional individual, however, refuses and makes trouble, and the legal authority to search persons or vehicles entering the United States, or vehicles moving interstate, is of great value in taking care of these special cases. There was considerable opposition to the passage of this legislation when it was first proposed several years ago, but this time it came up and was adopted by both Houses without objection from the floor.

In connection with our foreign relations, one complication arising during the year was that connected with the importation of Italian chestnuts. Such nuts are still arriving at the port of New York infested to a greater or less extent, but definite arrangements for treating them in that city have now been made and this plan is proceeding satisfactorily.

It will be recalled that a conference was held in 1925, at the request of the nurserymen, at which the matter of discontinuing the importation of fruit and rose stocks at some future date, was taken up. These stocks are the last important items still open to general and free entry into this country. Their admittance has been authorized since 1919 when Quarantine 37 was first adopted, because of the belief that such stocks were not available in the United States in adequate quantity and that foreign stocks were therefore essential. In other words, we seemed compelled to assume for a time the risk of importing pests attendant upon any such bulk importations.

The conclusions reached in 1925 were that the decision should be postponed for three years, during which period an effort would be made by the nurserymen to produce an adequate supply. This period of three years having come to an end last July, a further conference was held, the results of which were published in a press notice sent to most of the members of this association. The action taken is covered by the following phrase added on July 24, 1928, to regulation 3 of the Nursery Stock, Plant, and Seed Quarantine Regulations: "Stocks of apple, pear, quince and Mazzard cherry may not be imported under permit or otherwise after June 30, 1930."

Definite action with respect to the exclusion of rose stocks, Myrobolan plum, and Mahaleb cherry was postponed. Unfortunately during 1927 the western-grown rose stocks were unsatisfactory to many florists on account of an apparent lack of vigor. The difficulties are being studied and it is probable that the importation of these stocks can be discontinued at some future time.

The developments in connection with certain important domestic quarantines will in the main be left to Messrs. Hadley, Worthley and Burgess, who are present and on the program of this meeting.

With respect to the pink bollworm, the Department a year ago at this time was engaged in undertaking an extensive cleanup of the cotton fields in Arizona and western New Mexico to eliminate an incipient pink bollworm outbreak in the region. Every cotton field in these two States west of the Mesilla Valley was thoroughly stripped of cotton

and cotton stalks with the result that so far there has been no reappearance of the pink bollworm in that area. This cleanup operation involved a total of 12,121 acres, some 300 of which were covered by the State of Arizona.

A very serious development in the pink-bollworm situation was the determination, during the first three months of 1928, of the presence of this cotton pest in seven new counties of western Texas, viz., Ector, Midland, Martin, Andrews, Glasscock, Howard, and Dawson. Nearly 400,000 acres of cotton are grown in these counties, and this, together with the fact that the new area is on the edge of the main Cotton Belt and that cotton plantings are more or less continuous eastward to the Atlantic seaboard, gives this infestation a very much greater importance and makes it a greater menace than were the older and isolated infestations in western Texas, New Mexico, and Arizona.

After the extent of this new infestation had been disclosed, and to meet the emergency, the department, with the approval of the President, recommended that the item of $287,800 assigned for pink-bollworm work in the agricultural appropriation bill for the fiscal year ended June 30, 1928, be increased by $400,000, making a total of $687,800. Early in March, House Joint Resolution 223 was passed as a separate measure, making $200,000 immediately available and to remain available until June 30, 1929. At the same time the item in the regular appropriation bill for 1929 was reduced to $487,800, and the bill passed carrying that amount.

The immediate control plans carried out as to this area, in addition to bringing it under State and Federal quarantine restrictions, included (1) tracing and intercepting shipments out of the area likely to spread infestation; (2) sterilizing all cottonseed remaining in the area; (3) thoroughly cleaning gins, mills, and other concentration centers so as to destroy material likely to carry over infestation into the next crop year; and (4) increased precautions to prevent the influx of cottonseed from the older infested areas to the west. The failure to find living larvae in standing cotton seemed to render unnecessary the cleaning of the fields of dead stalks.

It was felt by the Department that the only safe way of eradicating this outbreak completely would be the establishment of noncotton zones, the plan which proved so successful in eliminating the infestations in eastern Texas and western Louisiana a number of years ago. Such establishment would, however, have been expensive and under the financial situation faced by the State of Texas at that time the entire

cost would have had to be borne by the federal government. Provision for this was made in an authorization for an appropriation of $5,000,000 which passed both Houses of Congress and was signed by the President on May 21, 1928. The item in the deficiency bill carrying the appropriation itself, however, included two amendments which destroyed much of its usefulness and have thus far made the appropriation unavailable. The first of the amendments required the finding of living worms within the counties in which the noncotton zones were established and the second consisted in a change in the wording under which the State would have been required to assume half the cost. The objection to the first of these amendments (which was carried in the authorization also) is that while only dead worms were found in the cotton bolls examined in the fields, there was a possible survival of the worms in the seed in the soil or in storage bins, mill trash and similar places. Such survival appears to have occurred as there has already been one discovery of living pink bollworms this past month at the southwestern edge of the newly-infested area.

The source of this spread in western Texas is not entirely certain. It was first supposed to have resulted from the illegal transportation of planting seed either from the infested areas along the Rio Grande or from the uncontrolled movement of Mexican labor with contaminated picking sacks and other equipment. Later evidence tends to point more strongly to the spread of the insect in strong winds from the intensive infestations in the Big Bend region or the less heavily infested areas in the Pecos Valley.

Investigations to determine the possible extent of wind-spread have been carried on by the Bureau of Entomology during the past summer and fall and will be continued next season. These studies show the presence of pink bollworm moths in upper air currents, giving further indications that this interesting and novel theory may be the correct explanation of the distribution of the insect. If so, it may become necessary to undertake, in cooperation with the Republic of Mexico, the total eradication of the pink bollworm from North America in order to protect the cotton belt from infestation.

A project which has worked out with unusual efficiency and satisfaction to everyone concerned is that relating to the Mexican fruit worm outbreak in the Lower Rio Grande Valley from Mission to Brownsville, Texas. As a result of the enforcement of quarantine restrictions and drastic cleanup operations, the insect has apparently been eradicated, no infested fruit having been found during the past two crop seasons.

As you know, the eradication program carried out there in cooperation with the State of Texas, provides for a seven months starvation period during which no fruit is permitted to develop or remain on the trees at a stage which would be attractive to the pest. The extent of local cooperation shown in carrying out this plan has been unparalleled in my experience. In a visit to the region in the early part of the year, I discussed the situation with civic leaders on both sides of the river, and the hearty spirit of sympathetic support was most marked. It must be realized that the region maintains an estimated population approaching 100,000, and presumably less than one-tenth of the people actually own citrus groves. Nevertheless, they have not only provided for the destruction of deciduous and other host fruits on home grounds before it has been permitted to ripen, but have in most cases destroyed the summer host trees completely, thereby losing shade as well as fruit. This has been done to a large extent without complaint and without legal pressure except in a very few cases.

A similar campaign was carried out on the Mexican side of the river, although Mexico has no citrus industry to be protected at the point. This was a particularly friendly gesture and was greatly appreciated by the citrus interests of southern Texas.

One important development of the year has related to the eradication of the Parlatoria date scale, a project being carried out for the permanent benefit and protection of the date industry of the Southwest. You will recall that the establishment of this industry is to a large extent an achievement of the Department of Agriculture, based not only on investigations by the Bureau of Plant Industry but also on actual importation of offshoots of promising varieties, and the establishment of experimental date gardens for their propagation.

The eradication of the date scale has proven to be a more difficult undertaking than was anticipated. The annual appropriations for this purpose were increased from $10,000 for the fiscal year 1922 to $21,760 for 1927. In November of the latter year, the discovery of several new and serious date scale infestations in California and Arizona served to throw doubt on the possibility of accomplishing eradication of the insect. As it was necessary to determine positively whether the undertaking was feasible, the personnel was reorganized and Mr. B. L. Boyden was transferred from the Bureau of Entomology to take charge and make a thorough survey in the three States concerned.

The survey so far as it has progressed up to the present, indicates that eradication is practicable and possible if adequate funds can be

supplied. The Department of Agriculture appropriation bill for the next fiscal year carries an item of $86,700 for that project, in part conditioned on the allotment of $35,000 additional from the States concerned.

Several new subjects have been taken up during the past few months and considered as bases for new domestic quarantines, and a quarantine with respect to one of them—the Woodgate rust—has been issued. The latter order relates to certain species of hard pines attacked by this disease in a number of counties in the northern part of New York State.

European larch canker has also been considered as a possible subject of a federal quarantine as a result of the discovery of this disease on eight properties in eastern Massachusetts and one property in Rhode Island. Evidence indicates the disease entered the United States more than 25 years ago but is still apparently confined to the limited areas stated. The importance of this disease rests primarily on the virulent manner in which it is attacking Douglas fir, a species which constitutes one-fourth of the remaining timber supply of the United States. Since Massachusetts and Rhode Island, in spite of having only a very limited amount of timber of susceptible species, have undertaken total eradication of the disease, federal action has been postponed pending determination of the results of this effort.

The most resent proposed subject of a federal quarantine is the phony peach disease. This is an infectious condition of peaches found widely prevalent in the peach orchards of central Georgia, but absent in other southeastern states. It is most extraordinary in its method of attack, the organism or virus seeming to be confined entirely to the root system, so that the disease is not transmissible by cions, branches or fruit of infected trees. In Georgia it is a source of serious loss, and a federal quarantine to prevent spread to other States is now being considered.

The enforcement of plant quarantines for the control of plant diseases and insect pests is in a general sense experimental, i.e. a demonstration of pest control on a large scale. This field of work therefore should be looked upon as an important and specialized branch of applied entomology rather than as something distinct and separate in nature and quality. It involves the work of hundreds of loyal, trained men whose daily operations result in the accumulation of new and valuable information and the development of new methods of control of insect or disease spread. There is no distinct and important demarcation, therefore, between such quarantine work and service and the work with regard to specific pests having relation to the farm or orchard or forests. In a

large sense, therefore, quarantine officials and personnel can look upon their jobs as having the natural and honorable character of experiment and research.

Before closing, I should like to recommend to this section, the adoption of a more informal type of program than the one now in use, involving a reduction in the number of prepared papers and the substitution of open discussions. Several subjects for such discussions may be suggested: such as, various features of the narcissus bulb regulations; the advantages and weaknesses of road inspection work; the desirability of continuing farm products control in attempting to reduce the spread of the Japanese beetle; transit inspection—methods and results; and the need of new national legislation to exclude plant diseases similar to the Insect Pest Act of 1905. In connection with the last named, serious attention should be given to the fact that plant disease cultures are being imported in great variety by students and investigators. They are offered in foreign catalogues and may be purchased and introduced without control by anyone. I can conceive of no greater risk to the agriculture and horticulture of this country than such importation of virulent infectious organisms which are not yet known to occur in the Western Hemisphere.

CHAIRMAN MCLAINE: We have all listened with a very great deal of interest to what Dr. Marlatt has said and we appreciate some of the difficulties that the new Plant Quarantine and Control Administration has faced in this first year of the work.

I notice that Mr. Strong from California has now arrived and I will call on him for his report of the National Plant Board. Mr. Strong!

REPORT OF THE NATIONAL PLANT BOARD

By L. A. STRONG

(Paper not received for publication)

CHAIRMAN MCLAINE: Is there any discussion on the report of this National Plant Board Mr. Strong has just presented?

DR. C. L. MARLATT: Mr. Chairman, I am very glad to have the statement from Mr. Strong relative to the action of the National Plant Quarantine Board in aiding in securing the legislation to which I referred. I don't think that detail of support had come to me clearly before; I certainly should have mentioned it. I am very glad to have that fact put on record.

I don't know whether it is appropriate to speak also of the aid which these Regional Boards and the National Board can give to the Federal administration in the securing of necessary funds for the support of its work. That is a very delicate subject and it is one in which mistakes are made more frequently than wise action taken.

As Mr. Strong has pointed out, no employee of the Department of Agriculture is permitted to give out any information about budget action until the action has been given to the public by the submittal of the estimates by the President to the Congress. There is no prohibition of the budget or of the President or the Congress, however, against the action which state men or anyone whosoever may take on their own motion. You have a right to be interested in the problems that concern your state or your district. You have a right to inquire of your members of Congress whether this work that ought to be done, and ought perhaps be done by the Federal Government, is being supported adequately.

The action such as Mr. Strong took, or rather such as the National Board took and the Regional Boards took in supporting the amendment to the plant quarantine act, giving this right of search, seizure, etc., was perfectly proper. That brought home to the members, the state representatives in the Senate, the fact that their own people were interested in that legislation and desirous of having it put on the statute books. It is a rather delicate subject and one which you will have to use your best judgment in connection with when you come to give support of that kind.

CHAIRMAN MCLAINE: In his address, Dr. Marlatt referred to the question of the Japanese beetle. He did not have time to more than merely mention the matter and I am very glad to say we have Mr. Hadley here who will talk to us on the spread of the Japanese and Asiatic beetles.

PREVENTING THE SPREAD OF THE JAPANESE AND ASIATIC BEETLES

By C. H. HADLEY, JR.

(Paper not received for publication)

CHAIRMAN MCLAINE: Is there any discussion of Mr. Hadley's paper?

DR. C. L. MARLATT: Mr. Chairman, an announcement just issued indicates we propose to treat isolated points infested by the Japanese beetle as separate areas. To swing a line around these outlying points would include a considerable portion of the eastern United States, whereas there are two or three hundred miles between infested areas.

The policy of taking charge of these isolated points as separate quarantine units is not a new policy; it is an old one. It has been exercised in connection with all of our quarantines up to the present time, the moth quarantines, the pink boll worm quarantines, and so forth.

I think it is a policy that doesn't need to be discussed. It is one that speaks for itself. You have always in the spread of a pest to expect some far-flung point which will have to be considered. The only problem that comes up is as to how far away such outlying points should be before you treat them as outlying points and as separate units.

I think it might be of interest always in connection with the Asiatic beetles to say what came out at our conference and hearings and what was reported by Mr. Smith and others, was strongly supported by the nurserymen who knew the records of importations; it seems clear these importations dated away back to the beginning of this century, sometime between 1900 and 1904 or 1905 or 1906, when, according to the nurserymen, there were large importations from the Orient, Japan and other countries. Evidently these beetles being much slower in development and in spreading were longer in coming into notice.

CHAIRMAN MCLAINE: The European corn borer needs no introduction to this section, and I do not think that the man who has been charged with keeping it back needs any introduction. I have much pleasure in calling on Mr. Worthley.

ENFORCEMENT OF THE EUROPEAN CORN BORER QUARANTINE IN 1928

By L. H. WORTHLEY

ABSTRACT

Enforcement of the European corn borer quarantine in 1928 consisted in the operation of 179 quarantine posts in New York, New Jersey, Connecticut, Pennsylvania, Ohio, Michigan and Indiana. These lines covered a frontage of approximately 1450 miles. Lines were operated similar to what they have been in previous years. 6,873,961 automobiles were stopped and searched this season. Season of operation was from July 18 to September 30th and required the services of 612 men. 327,288 ears of corn were taken at the lines. In the western area 390 borers were found in 370 ears of corn confiscated; in the central area 242 borers were found in confiscated material. Co-operation we received at the lines was very excellent. Quarantine work in the Boston market district was quite strenuous during the season. Lima beans were found to be severely infested and as many as 365 borers were found in one bushel of beans. In one instance 35 ears of corn contained 34 borers, destined to a point in central New Jersey. During the period January 1, 1928 to December 1, 1928, we inspected and certified 4,012,546 bushels of grain and seed corn.

The quarantine on account of the European corn borer has been in operation for several years and each year there are new developments to be given consideration. The past season it was necessary to add some areas not actually found infested, such as New York City and the territory east of the Hackensack River and Newark Bay in New Jersey. The necessity for this was that in Long Island where considerable green corn is raised, the infestation had developed and increased to such an extent that the shipment of green corn into New York City and distributions made from that point were apt to be a menace to non-infested territory.

The regulated area from the eastern end of Pennsylvania through Pennsylvania, Ohio, Indiana and Michigan was confined almost entirely to actually infested areas, only a few non-infested townships being added to the quarantine for market purposes or to simplify the operation of quarantine lines. These lines covered a frontage of approximately 1450 miles.

This year 179 quarantine posts were operated in addition to the New York ferries, in the one-generation area from New York City west, and at the majority of these points it was necessary to operate 24 hours each day. Practically the same equipment as that used in previous years was utilized. The 16 and 24 hour lines were equipped with acetylene lamps in order that the inspectors would have sufficient light to operate in an efficient manner. The Bomb-shell torches and warning signs were used on all quarantine lines and gave very satisfactory results. The number of vehicles refusing to stop and passing the quarantine lines was very small and the percentage as compared with the whole was almost negligible. 6,873,961 automobiles were stopped and searched this season. This work required the services of about 612 men. The season of operation was from July 18 to September 30, although in the eastern area some of the lines were not discontinued until the latter part of October. The number of ears of corn taken at all lines was 327,288. In the western area 390 borers were found in 370 ears of corn confiscated at the lines. In the central area 242 borers were found in corn confiscated at the lines. I might say in this connection that it was not possible to inspect every ear of corn that was confiscated but another year we hope to be able to increase our force sufficiently to allow the inspection of every ear of corn seized at the lines.

Corn taken at some of these lines was destined to points in Iowa, Wisconsin, California, Missouri, Minnesota, Colorado, New Mexico, Canada, Texas, West Virginia, Illinois, Maryland, District of Columbia.

Nebraska, Virginia and Georgia. A considerable amount was consigned to Chicago. Some of the corn was found to be infested and some of it was not infested. It is necessary, however, to confiscate all corn in transit for points outside the quarantined area in order to prevent the spread from this source. Borers have been found in shipments of corn destined to points a considerable distance from the limits of the quarantined area and to territories where large acreage of corn is grown. It can easily be conceived that circumstances of this nature might lead to infestations starting in any of these areas, as it is quite probable that upon examination, the corn would be discarded if found to be severely infested.

The co-operation which we have received at the lines this year might well be considered as excellent. There were a few instances where people were inclined to use their influence to avoid the annoyance of being stopped at the lines. This caused some little trouble. In almost all cases, however, when complaints were made, the injustice that was charged was found to be greatly exaggerated and investigation proved that the inspectors were simply endeavoring to make a thorough examination. If a complete examination of all automobiles and vehicles is not made, the value of the operation of these lines is not sufficient to warrant the expense. Motorists readily conceive the idea of carrying corn in concealed places and if we do not open the backs of the runabouts, etc., a great deal of corn would be carried outside the area.

It was also found necessary this season to place a quarantine against produce from the Massachusetts area going into the State of Maine. This applied very largely to corn and lima beans. Corn and lima beans coming from the section of Massachusetts near Rhode Island and the eastern part of Rhode Island were found to be severely infested. These products were being shipped to Maine in large quantities. Maine has regulations compelling Fall plowing and has taken great pride in the enforcement of these regulations. The borer has been kept down to a minimum and it was considered an injustice to allow severely infested corn and lima beans to be shipped into that State without restrictions. Consequently, the quarantine was amended prohibiting such shipments. Quarantine lines were operated on several of the main roads leading from New Hampshire to Maine for the purpose of preventing the people from carrying these products into the State of Maine.

The quarantine inspection work in the Boston market this year has been much more strenuous than it has been for several years. Lima beans, previously mentioned, were found to be very heavily infested

and as many as 365 borers were found in one bushel of beans. Some of the cut flowers, dahlias, gladiolus, etc., were found quite heavily infested, especially dahlias raised for exhibition purposes. These flowers are frequently shipped long distances and it is very necessary that close attention be given to them to prevent long distance spread. Early corn in some sections of Massachusetts and Rhode Island was also heavily infested and in one instance when five bushels were shipped to a hotel in York, Maine, not one ear was suitable for use. Owing to the density of the New England infestation, the quarantine work in that region must necessarily be enlarged the coming season. The co-operation we have received from the growers, market men and transportation companies in the New England area has been most excellent and in few cases have we found persons trying to disregard the regulations.

The operation of the quarantine in New York City has also proven to be very strenuous, owing to the large amount of green corn shipped into New York City from the South, prior to the appearance of native corn on the market, and the necessity of permitting reshipments of this corn to points outside the city. However, the quarantine was started there when the corn coming from Long Island was quite lightly infested, giving us an opportunity to establish this station and make the operation of the quarantine much more effective another year, when, in all probability, corn coming from Long Island will be more severely infested. In one instance, 35 ears of corn confiscated contained 34 borers, the destination being a point in central New Jersey.

While the operation of all quarantine lines and quarantine work in general, on account of the European corn borer, is quite expensive each year, it more than proves its value in the amount of corn and infested material taken and prevented from going far into non-infested territory.

During the past season all quarantine lines were operated with Federal funds and under Federal supervision regardless of whether they were inter-state or intra-state lines. In the case of intra-state lines, the Federal men were deputized by the States. We received good co-operation along this line, with one exception, when a Governor interfered with the proper execution of the quarantine line work in his State.

Plans are now being formulated for even more quarantine lines than in previous years as the infestation is becoming more severe in localities in the Middle West and the danger of spread increases owing to this fact.

The inspection of shelled corn was conducted along similar lines as in previous years and very excellent co-operation has been received from grain elevators, brokers, and transportation companies. The quaran-

tine on shelled corn on account of the European corn borer has proven of considerable value other than in preventing the spread of the insect as it has brought about methods of cleaning corn much better than those previously used and it is a common occurrence now to have brokers order corn within the infested area specifying that it be "corn borer cleaned."

During the period January 1, 1928 to December 1, 1928, in the western area, there were approximately 2,038,345 bushels of grain and seed corn certified for shipment.

In Pennsylvania and New York for the same period, there were 1,974,201 bushels of grain certified for shipment.

The meeting adjourned at twelve-thirty o'clock.

Thursday Afternoon Session, December 27, 1928

The meeting was called to order by Chairman McLaine at two o'clock.

CHAIRMAN MCLAINE: The first paper on the program this afternoon is one that we had to leave over from this morning's session.

THE PRESENT STATUS OF GIPSY MOTH, BROWN-TAIL MOTH AND SATIN MOTH CONTROL

By A. F. BURGESS, *Melrose Highlands, Mass.*

(*Summary*)

Work in New Jersey was begun in 1921 and has been carried on in direct cooperation with the State Department of Agriculture. The generally infested area embracing originally over 400 square miles, together with nine isolated outlying colonies, has been thoroughly inspected and treated. These colonies were promptly cleaned up but it has been necessary, since work was attempted in the area which was densely infested, to cover a much wider area as a precautionary measure in order to make sure that the insect was not established in surrounding territory. A section embracing more than 2300 square miles has been scouted in New Jersey, and during the last few years the area where operations have been carried on has been greatly reduced. Very intensive work has been necessary in the 400 square mile area originally infested and the territory where operations are now being conducted has been reduced to 197 square miles. Only four small colonies were found during the last fiscal year and rapid progress is being made in completing this project which has for its object the extermination of the gipsy moth in New Jersey.

The barrier zone operations in western New England and eastern New York have been conducted for the past five seasons and the westward spread of the insect has been checked. Progress has also been made in cleaning up isolated colonies, the most striking results having been secured in the northern and southern sections of the zone. In the zone area located in southwestern Massachusetts and northwestern Connecticut, and territory adjoining it in New York, more colonies have been found and treated than in other parts of the zone. The entire project has produced satisfactory results and for five years has protected the rest of the United States from the continuous spread of this insect.

Since 1924, when the acreage defoliated by the gipsy moth in the eastern part of the infested territory was the smallest of any time during the previous 20 years, there has been a rapid increase in the abundance of the insect and the areas defoliated. Attention has frequently been called to the fact that if the insect increased rapidly immediately east of the zone it would make the maintenance of a clean zone increasingly difficult. Reports were received last year from the States concerned and from other sources that the insect was increasing rapidly in the towns between the Connecticut River and the barrier zone. A recommendation was made for additional funds in order to scout this territory and clean up the colonies that had become established. No funds were made available for this purpose and conditions at present are far more threatening than heretofore. The previous recommendation has been renewed in order that this important work may be given attention before it is too late. Unless active scouting and clean up operations can be taken up so as to prevent continuous reinfestation of areas in the zone that have already been cleaned it will eventually become necessary to move the zone westward into a region embracing sections of the Adirondack and Catskill mountains which will be far more difficult and expensive to manage and the effective results that have been accomplished will be lost.

This problem vitally concerns all the territory in the United States west of the zone as protection from infestation and consequent damage and money loss rests primarily on the effective maintenance of the zone. The states to the westward, therefore, should be vitally concerned in the effective operation of this project. A recommendation has also been made that sufficient funds be made available to scout a limited amount of territory along the quarantined area in Maine and northern New Hampshire to determine whether this quarantine border should be relocated. Owing to the necessity of expending the available funds

in the barrier zone this border has not been scouted for several years. This work should be done in order that the area if found infested may be covered by quarantine to provide for the proper inspection of materials that are being moved to uninfested territory.

The brown-tail moth is being held in check in most of the infested territory as a result of local field control operations, the work of parasites and natural enemies and the periodical effect of adverse climatic conditions, particularly low temperatures in the winter. In several areas, particularly in some of the seaboard towns in northern Massachusetts, New Hampshire and southwestern Maine and in some of the river valleys in New Hampshire and Massachusetts, heavy infestation occurred during the past year. The insect can readily be controlled by the destruction of winter webs and proper spraying, and as it is not primarily a forest pest it does not present as difficult a problem as is the case with the gipsy moth.

The satin moth has continued to spread each year and has extended its range to a group of towns west of the Connecticut River in Vermont, Massachusetts and Connecticut as well as to additional towns in New Hampshire and Maine. As it attacks the different varieties of poplar and willow exclusively and can be controlled by proper spraying, it is not destined to be a severe pest to forests in the east unless it should become extremely abundant in poplar woodlands which are valuable for pulp wood. Shade and ornamental trees of the varieties mentioned have been severely defoliated in the infested area during the past year and the expense of proper spraying is far greater than many owners are able to meet. In many towns this insect has become a nuisance owing to the excessive numbers of the caterpillars that defoliate the trees and swarm upon the buildings and into the houses, and unless more thorough treatment is applied many of the infested trees will die in the near future.

The satin moth quarantine has been extended to cover the new territory known to be infested. Shipments of poplar and willow trees are prohibited from the quarantined area to points outside. This regulation is necessary as the small caterpillars hibernate in crevices of the bark and cannot be readily detected during the dormant season by ordinary methods of inspection. The same quarantine regulations apply to several counties in the state of Washington where this insect is known to occur.

CHAIRMAN MCLAINE: Is there any question or discussion?

Mr. ARTHUR GIBSON: Mr. Chairman, Mr. Burgess referred very kindly to the work which we have been carrying on in the Dominion

of Canada, particularly in connection with controlling the gipsy moth. Some of you may recall two years ago we had a real infestation, particularly in the district of St. Hendricksburg and since that time this little town has become quite famous through the infestation of the gipsy moth. I am glad to be able to report, however, starting in the last two years they have effectively controlled the gipsy moth in that territory. We have not found a single nest in any of the area within the last two years and we hope the infestation has been eradicated.

In all of that work through the cooperation of the Quebec Department of Agriculture, we expended approximately $100,000. I should like to take this opportunity to thank the officials of the United States Bureau and also the New York state officials for the very kind, sympathetic cooperation which they gave to us during that campaign.

Regarding the brown-tail moth, as many of you know, we have had rather serious infestations in our Maritime provinces. We have reason to believe the outbreak in New Brunswick is entirely eradicated, and we hope also the infestation in Nova Scotia has been entirely wiped out. Within the last two years, we have only found a very few nests in the Province of Nova Scotia.

As to the satin moth, Mr. Burgess may be interested to know, during the last summer in company with one of our western men, I went over the territory and I regret to report the satin moth has increased in that territory to quite a serious extent. This year we found in addition to aspen, poplar and Lombardy poplar, the willows very badly defoliated in certain sections, as far as 70 or 80 miles north of the city of Victoria. That was all new territory so far as we know. The pest is certainly very bad this year, but we are hoping to introduce some possible quarantine measures so we may have an opportunity of preventing the spread to other districts.

CHAIRMAN MCLAINE: Is there any further discussion?

Mr. F. N. WALLACE: I would like to ask if it hibernates on anything except poplar or willow.

Mr. A. F. BURGESS: Not so far as we know on the living trees. The smaller caterpillars, after they are hatched and fed and molted once, gnaw a little crevice in the bark and go into that crevice, spin silk and cover themselves in for the winter, and particularly where poplars are grown, or willows, in a place where there is a good deal of dust or smoke, it is almost impossible to see those webs.

While I am on my feet, I would like to say this: We have quite a large representation here today from many sections of the country. Some of

you may think that the gipsy moth problem is essentially a local problem and a New England problem, and has been fought down there for a good many years and it has never troubled anyone very much who lived at a distance outside the area. I would like to have you think about this matter: All of the work and all of the money (I mean federal money) that has been spent on that problem has been spent primarily to protect the people who live and the people who own property outside the infested area. The reason that you don't have gipsy moth in many of these states in the Mississippi Valley, possibly to the South and farther to the West is because of the work that has been going on year after year for your protection. That is true, of course, with all pests. In the territory where the insect is bad, it has caused enormous local expense and the people have met that expense for the protection of their own property. I hope that by a study of the map those of you who come from a distance will realize that all this effort that has been put forth in the past has protected you and your constituents from the expenditures that have had to be made by the states where this insect has become established and has been doing damage.

Mr. T. J. HEADLEE: Mr. Chairman, in the opinion of Mr. H. L. McIntyre, of New York, who is in charge of gipsy moth work in New York, and in my own opinion the successful continuance of the barrier zone is seriously threatened by the lack of funds necessary to prevent the building up of infestation in that zone in western Massachusetts and also in Connecticut and lower Vermont. I think we need to consider this matter very carefully and should extend a helping hand if we want to continue to be protected against the outward movement of the gipsy moth.

CHAIRMAN MCLAINE: The next paper is by Max Kisliuk, Jr.

A BRIEF SUMMARY OF FRUIT FLY SURVEYS IN ARGENTINA, SPAIN AND THE CANARY ISLANDS

By MAX KISLIUK, JR., *Associate Plant Quarantine Inspector*

ABSTRACT

In 1927 the writer made a number of fruit fly surveys for the United States Department of Agriculture. In Argentina the West Indian fruit fly was found in fruits grown in the North and Northwestern Provinces. The Mediterranean fruit fly was taken in the Province of La Rioja, and it is also recorded as having been found in the past in the province of Buenos Aires.

In southern Spain grapes were still found infested with the Mediterranean fruit fly in 1927, but tomatoes were not found so attacked either in Spain or in the Canary Islands.

Anastrepha fraterculus Wied.[1]

In 1918, Mr. E. W. Rust (1), who had been stationed in Northern Argentina, published a good account of the damage done by the West Indian fruit fly, *Anastrepha fraterculus* Wied., to various fruits grown in that region, especially in the Province of Tucuman, and stated that he thought this fly was either indigenous to that area or had been present there for several decades. The same species was found by Mr. G. F. Moznette (2) in peaches and apples grown in the Province of Tucuman early in 1925; also peaches said to have originated in the Province of Cordoba which were purchased in the Buenos Aires market were found to be similarly infested. Just about this same time Mr. Frank E. Todd (3), who had been on other entomological investigations in Argentina, observed some fruit fly larvae, suspected of being *A. fraterculus*, in peaches from Olives, a suburb of Buenos Aires.

During the months of February, March and April of 1927 (4) the writer searched for fruit flies in the principal fruit growing districts of central Argentina (San Pedro, Mendoza, and San Juan) but did not discover any in that section of the country.

Late in April and in May and June, however, he collected adults and larvae of the West Indian fruit fly on and in various citrus fruits, apples, and guavas, in the northern provinces of Tucuman and La Rioja. Some adults were also presented to him by a local inspector who claimed to have bred them from the large Japanese persimmon grown in Tucuman.

Ceratitis capitata Wied. in Argentina

The Mediterranean fruit fly, *Ceratitis capitata* Wied. was first reported in Argentina in 1905 by Lounsbury (5), who stated that he had taken it in the Province of Buenos Aires. For some time this record was considered doubtful. In 1917, the late Dr. Juan Brethes (6), however, definitely determined as this species flies which had been bred from peaches in the vicinity of Dolores, Province of Buenos Aires in 1913. He also sounded a warning for Argentinians to cooperate in controlling this terrible pest which would no doubt find the climate of the province agreeable for its establishment. Larvae found in Argentine quince (7) by Federal Plant Quarantine Inspectors at New York in 1922 were recognized as *C. capitata*. In 1926 inspectors at the same port found the larvae of this fruit fly in grapes which were said to have originated in the provinces of San Juan and Mendoza but which later proved to have been grown in the Province of La Rioja (8).

[1]All fruit flies collected were determined by C. T. Greene.

Early in June of 1927 the writer took larvae of *Ceratitis capitata* Wied. in the Province of La Rioja in grapes left after the main crop had been harvested and shipped to Buenos Aires. An adult of this fly labeled "Province of Buenos Aires 1919" was also found in an entomological collection.

Ceratitis capitata Wied. in Spanish Grapes

Since 1842 the Mediterranean fruit fly has been definitely known to occur in Spain (9). The Ohanes, Malaga or Almeria grape, which had been allowed importation into the United States was, however, not known or suspected to be a host for this pest until inspectors of the Federal Horticultural Board at New York found infestations in imported Spanish grapes of the 1923 crop (10). Several fruit fly surveys (11) have been made in southern Spain, some before and some since that time, but the investigators were either too early or too late for the grape harvest. The writer, during the latter part of September and October of 1927 (12), had no difficulty, however, in finding larvae of this fly in grapes on the vine as well as at the packing centers in the Province of Almeria. Adult Mediterranean fruit flies were reared from these grapes, and the persistence of the infestation in the region was therefore evident.

Ceratitis capitata Wied. not Found in Tomatoes

While investigating the Mediterranean Fruit fly in connection with grapes in the Province of Almeria, a request was made for information on tomatoes as a possible host in this same region. Accordingly, many tomatoes were dissected in southern Spain but no fruit fly larvae were found.

A similar investigation was made in November, 1927, of the tomato crop of the Canary Islands, as the value of the exports of tomatoes from that region is exceeded only by that of bananas. On the two largest and most important of these islands, namely Gran Canaria and Teneriffe, the Mediterranean fruit fly larvae were found very common in oranges and other semi-tropical host fruits; and adults were extremely numerous on these fruits. At the same time, however, dissections of thousands of tomatoes in various stages of ripeness ranging from green to over-ripe and rots failed to show a single fruit fly larvae and during the course of field studies adults were never observed resting on tomato plants or ovipositing in the fruits.

These observations confirm the work of Back and Pemberton (9) in Hawaii where tomatoes were not found attacked by this fly in the field

nor at the fruit and vegetable stands, although they would become infested after a severe forcing in a confined insectary under artificial conditions (13). Fruit fly larvae have at various times been reported as having been found in Hawaiian tomatoes intercepted at California ports, but as adults were never reared it is probable that the specimens were larvae of the melon fly rather than of the Mediterranean fruit fly.

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Mr. L. A. STRONG: Mr. Chairman, Mr. Kisliuk mentioned finding fruit flies in Rioja. How near is that to the fruit that comes from Mendoza and San Juan?

Mr. MAX KISLIUK, JR.: It was in the adjoining province north of San Juan, but there is quite a severe, tall range of very rugged mountains between those two provinces. There is only one railroad running between the provinces. There are no roads, perhaps slow mule tracks here and there, but they are very scarce between the two provinces. This railroad comes from the provinces still further north from La Rioja and has a junction south and an intake only twice a week into the province of San Juan from the north, although there are regular trains from Buenos Aires to San Juan. From the north there are only two trains a week. At the present time the traffic is so small, no fruit being shipped from the north, since San Juan is producing all that they can use themselves and enough for export, too. At the present time there is no danger of fruit fly from San Juan, but there may be some in the future.

Mr. R. W. HARNED: I understood Mr. Kisliuk to say he saw a field of bananas ruined by Argentine ants.

Mr. MAX KISLIUK, JR.: Yes, sir. They devoured the plants.

CHAIRMAN MCLAINE: Dr. H. H. York of Albany, N. Y., will now present a paper.

THE WOODGATE RUST

By HARLAN H. YORK, *Forest Pathologist, Conservation Department, Albany, N. Y.*

The Woodgate Rust is a fungous disease which occurs on two and three needle pine trees. It attacks the tree through the stems and causes the development of spherical or knob-shaped swellings, which are known as galls. It is one of a number of gall rusts. This disease was discovered by the writer near Woodgate, N. Y., early in June 1925. For the lack of a better name it is known as the Woodgate Rust. There is but one species of gall rust native to northeastern North America, namely

Cronartium cerebrum. This disease occurs primarily on our native hard pines, such as *Pinus banksiana* and *P. rigida*. It also extends into the Southern Atlantic states and attacks various species of hard pines native to this section of the country.

The galls which are produced by these two rusts are strikingly similar, yet the life histories of the causal organisms are strikingly different. *Cronartium cerebrum*, like most plant rusts, has two host plants, namely, species of hard pines and of oaks. Its spore forms are pycniospores, aeciospores, urediniospores, teliospores, and sporidia. The pycniospores and aeciospores are produced on the pines. The aeciospores infect the leaves of various species of oaks, resulting in the production of urediniospores and teliospores. From the teliospores, the sporidia, which are the pine-infecting spores, develop. The sporidia infect the pine trees through the needles. The species of oaks are the so-called alternate hosts of *Cronartium cerebrum*, and they are necessary for the spread of this fungus to hard pines. The Woodgate Rust has no known alternate hosts, hence produces no urediniospores, teliospores and sporidia. It produces only aeciospores, which serve to spread the fungus directly from hard pine to hard pine. Pycniospores have not been observed. Thus the Woodgate Rust is autoecious while *Cronartium cerebrum* is heteroecious.

Although the galls of the Woodgate Rust and *Cronartium cerebrum* are somewhat similar in shape, they can, with a little study, usually be distinguished from each other. The galls of the Woodgate Rust as a rule are somewhat oblate, i.e., the longitudinal axis is less than the transverse diameter. The margins of the galls are usually marked with a well defined rim or collar of bark. In the case of the galls of *Cronartium cerebrum*, the longitudinal diameter is usually longer than the transverse axis; and, as a rule, there is no well defined rim or collar of bark at the margins of the galls. Aeciospores of the Woodgate Rust develop in more or less irregularly shaped, confluent aecia, while those of *Cronartium cerebrum* are rather cerebroid, i.e. resembling the convolutions of a brain.

At Woodgate, N. Y., the aeciospores of the Woodgate Rust are produced primarily in the month of June. They infect the pines directly through the epidermis of the new or current season's stem growths. About one year following infection, swellings of the twig at the point of infection first become noticeable and two years later (three years from infection) the galls produce aeciospores. Galls may produce annually crops of spores until they become at least six years old and from that time on more or less in intermittent seasons. Galls 20 to 23 years of age have been observed to produce aecia in three successive seasons.

Trees of all ages may be attacked by this disease; seedling trees are usually killed within a few years, young trees becoming infected may survive to 20 or more years. But as a rule, they become so malformed and stunted they are rendered unfit for timber and eventually die. More than 18,000 galls were counted on a single tree. Some trees are apparently resistant to the rust.

The source of the Woodgate Rust is unknown. It is attacking Scotch pine trees, *Pinus sylvestris*, at Woodgate, where there are extensive plantings of this species. These plantations were established intermittently from 1870 to about 1884, by the broadcasting of Scotch pine seed, which the original owner imported from Bavaria. He kept very detailed diaries of all his farm activities and no mention is made of bringing any trees to his farm except apple trees. Gall rusts are not known to occur in Europe. Since there are a number of species of these rusts in the Pacific states in our own country as well as in Asia, it is evident that the Woodgate Rust must have come from one of these regions. It has been in the Woodgate region about 30 years. Its spread up to about 1920 was slow, since then it has been making very rapid progress. No explanation is at hand as to why this disease should become so active, and acquire a rather dangerous magnitude. Nevertheless, its behavior in this respect is strikingly similar to that of other foreign introduced pests, as, for example, white-pine blister rust.

The investigations on Woodgate Rust, which are being conducted by the Conservation Department of New York in cooperation with the U. S. Department of Agriculture, show that a number of hard pines, such as the western yellow pine (*Pinus ponderosa*), Japanese black pine (*P. thunbergii*), Corsican pine (*P. nigra* var. *poirettiana*), Jersey pine (*P. virginiana*), loblolly pine (*P. taeda*), and others, are susceptible to the Woodgate Rust. Other hard pines, which were inoculated in 1928, appear to be infected.

It is not possible to predict with certainty at this time how serious the Woodgate Rust may become. It is becoming extremely active. The inoculation experiments show that infection readily occurs at relatively high temperatures. It is strongly destructive to young trees. These facts indicate that this disease may become a very serious menace, if it becomes established in the warmer sections of the United States, particularly the South Atlantic states, where there are vast areas of young reproduction of hard pines.

Our present knowledge at least shows that the Woodgate Rust is destined to become a "sapper" which will increase the toll exacted annually from our forests by diseases and insects.

CHAIRMAN MCLAINE: We are to have another paper on plant pathological lines by F. L. Drayton, of Ottawa, who recently spent four or five months in Holland and Europe generally in connection with bulb diseases. I will call on Mr. Drayton.

BULB DISEASES IN EUROPE

By F. L. DRAYTON

ABSTRACT

The visit paid to Holland and other European countries arose out of an invitation issued to the Canadian Destructive Insect and Pest Act Board by the Netherlands Government to have a plant pathologist sent there, at their expense, to see the general methods of handling the bulb crops and to assist in every way possible in outlining a procedure for the eradication of the gladiolus diseases.

The three types of inspection practiced in Holland are described, *viz.*

1. The form of field inspection conducted by the growers.
2. The field inspections done under the direction of the Hyacinth and Narcissus Associations.
3. The bulb house inspection prior to shipment conducted by the Phytopathological Service at Wageningen.

Lantern slides are given of the principal diseases found in bulbs imported into Canada from Europe. The types of bulbs included the tylip, hyacinth, narcissus, gladiolus, crocus, freesia, snowdrop, and bulbous iris.

Mr. MILTON: I would like to ask how many of these diseases are prevalent in this country of those you have described.

Mr. F. L. DRAYTON: As far as our commercial gladioli are concerned, the dry rot is quite severe in places. We have carried on a campaign among our growers and outlined various methods of elimination from their stock which has been successful. As far as scab is concerned, that is not a very serious disease in our country and apparently was not very serious in Holland. I didn't see very much of it. As to the other fall planting bulbs, in Canada the only area where there is any commercial growing of narcissus, hyacinths and tulips, is in British Columbia. I haven't visited that province yet, but I understand the hyacinth yellows is giving a great deal of trouble. I can't speak for any of the others.

Mr. CLEMENT: What control measures are being used in Holland for the basal rot of narcissus?

Mr. F. L. DRAYTON: I am glad to see there are two papers on that subject in the Phytopathological Society program. I made a great many observations. No control measures have been carried out because the fungus is not understood. To begin with, the time of infection is not known. It is definitely confined to certain varieties and my own im-

pression after observing it in many places was that the infection occurred after the bulbs were dug. I may be wrong about that. But certainly what observations I made led me to believe that there is a great deal of work to be done in that disease. I understand it is quite prevalent in this country, too.

Mr. R. L. CLEMENT: Do you think flies carry the spores?

Mr. F. L. DRAYTON: No, I do not, because I have examined many hundreds of specimens not only in Holland, but after the shipments have arrived in Canada, and I have never known any insect in the bulb. It was always the basal rot and that only. I have never found eelworms. I have examined thousands and never found eelworms associated with basal rot, even some authorities of England have stated eelworms are always the primary in case of the residual basal rot, but I have never been able to verify the fact.

Mr. R. L. CLEMENT: I meant the bulb flies. I thought maybe they carried the disease.

Mr. F. L. DRAYTON: I have never noticed any infestation in the bulbs infected by the basal rot.

CHAIRMAN MCLAINE: We will proceed with the next series of papers on the subjects of important state quarantines, the first being by Mr. J. D. Winter.

RASPBERRY MOSAIC

By J. D. WINTER, *Division of Nursery Inspection, St. Paul, Minn.*

ABSTRACT

Five groups of virus diseases of the raspberry are now recognized—leaf curl, red raspberry mosaic, mild mosaic, yellow mosaic and streak. Whether each group consists of a single virus or of several different viruses is not definitely known. Conditions seem more favorable for combating this type of disease in the bramble fruits than in many other agricultural crops. The known insect vectors are not general feeders and their feeding range is restricted to the bramble fruits. It has been demonstrated in several states that disease-free planting stock can be produced by careful inspection and by the proper eradication of all infected plants as soon as infection appears.

The Central Plant Board, representing thirteen states, has adopted recommendations for the uniform inspection and certification of raspberry plants. Four states have enacted quarantine regulations concerning the entry of these plants. Owing to the general prevalence of these virus diseases it appears that this problem should become a part of the general movement for greater uniformity in methods of inspection rather than a problem concerning quarantine action.

One of the earliest records concerning virus diseases of the raspberry was made by Green (1) in 1895. He stated that for five years a disease

known as "leaf curl" had seriously affected almost every variety of red raspberry on the grounds of the Minnesota Agricultural Experiment Station and that the ravages of this disease were widespread over the country.

Five groups of virus diseases of the raspberry are now recognized—leaf curl, red raspberry mosaic, mild mosaic, yellow mosaic and streak. All are found on the black raspberry. Leaf curl and red raspberry mosaic are the only important virus diseases of the red varieties. Symptoms similar to red raspberry mosaic are found on the blackberry and dewberry. Dodge and Wilcox (2) state that streak is found on certain purple raspberries but is not known on red varieties. Whether each group consists of a single virus or of several different viruses is not definitely known. Bennett (3) indicates that there are intermediate types of mosaic between the mild mosaic which is common on black varieties and the more virulent form on red varieties.

Mild mosaic is the most prevalent virus disease of the black raspberry. It seems to cause a gradual reduction of the crop and to shorten the productive period of a planting. This type of mosaic is found on the red raspberry but apparently is of no importance except as a source of infection to black varieties. The control of this disease is particularly difficult because symptoms often become almost or entirely masked at ordinary summer temperatures. Systematic roguing for mild mosaic is being carried on in Michigan. The most practical recommendation may be to secure clean propagating stock from sections where conditions are favorable for the eradication of this type of mosaic.

Red raspberry mosaic is by far the most prevalent and most destructive virus disease of the red varieties. The development of symptoms and extent of injury vary a great deal according to the variety affected. Consequently, some experience with the variety involved may be required to recognize the disease and to avoid confusion with injury due to such other causes as powdery mildew, red spider, and frost. Symptoms are not so readily masked by summer temperatures as with mild mosaic. Masking due to temperature usually is not a serious factor in the roguing of most of the important commercial varieties of red raspberry. Red raspberry mosaic causes severe injury when infection occurs on the black raspberry, but is not known to be prevalent on black varieties.

The general symptoms of yellow mosaic, leaf curl and streak seem to be fairly constant. These diseases are quickly and severely injurious to infected plants. The appearance of yellow mosaic is quite characteristic

and this disease is easily eradicated from black raspberry plantings. Leaf curl is easily recognized but may be difficult to eradicate when abundant. Certain varieties of the red raspberry are particularly susceptible to leaf curl. Streak is probably responsible for more injury to the black raspberry than any other of the virus diseases. It is not so widely distributed as mild mosaic, but is very prevalent in some sections.

The only means by which any virus disease of the raspberry is known to be transmitted from an infected plant to a healthy plant is through the agency of the aphid. Inoculation by the injection of plant juices from diseased plants has not been successful in transmitting infection.

Only four species of aphids are widely distributed on the raspberry in North America, namely, *Amphorophora rubi* (Kalt.), *Amphorophora rubicola* (Oestlund), *Amphorophora sensoriata* Mason and *Aphis rubiphila* Patch. These aphids are not known to feed on any plants except the bramble fruits. According to unpublished data of the writer, *Aphis rubiphila* Patch is identical with *Aphis rubicola* (Oestlund) which was described by Oestlund in 1887. Bennett (4) has shown that *Amphorophora rubi* will transmit red raspberry mosaic, yellow mosaic, and mild mosaic, but seems unable to transmit leaf curl. Bennett and others have found that *Aphis rubiphila* will transmit leaf curl readily. Until more information becomes available it seems desirable to consider each species of aphid as a possible vector.

It is well known that some of these virus diseases are more prevalent on certain raspberry varieties than on others. One reason may be that certain varieties have not been exposed to infection so much as have others. Another reason is that certain varieties may be naturally resistant to infection. This appears to be true of the Cuthbert, which seems quite resistant to red raspberry mosaic. A third reason is that the insect vectors exhibit a decided preference for certain raspberry varieties. The writer has unpublished data showing that the aphid *Amphorophora rubi* has difficulty in maintaining itself on the variety Herbert and is very rarely found on this variety under field conditions in Minnesota.

Inspection for these virus diseases must be made during the growing season, as terminal inspection of dormant stock is of no value except to determine whether proper certification tags accompany the plants. It has been demonstrated in several states that disease free planting stock can be produced by careful inspection and by the proper eradication of all infected plants as soon as infection appears. Control of these virus diseases to the point of complete eradication usually is not possible unless the grower understands how infection spreads and watches

closely for infected plants. The grower must learn that the responsibility for maintaining a disease-free planting rests with him and not with the inspector.

The first roguing should be done in the spring as soon as symptoms appear and before aphids become abundant. In a well established planting of red raspberries grown for the production of plants, it is usually not practicable to attempt roguing when more than 5% of the hills are infected. Black raspberries may be rogued successfully when a higher percentage of infected plants is present because they do not produce root sprouts and the plants are more easily eradicated.

Great care must be taken to avoid the distribution of aphids from diseased plants at the time of roguing. When aphids are numerous, infected plants should be burned before being dug or be carried from the field in canvas or in some suitable container and burned before the foliage wilts. It is probably safe to omit burning if the infected plants are carried some distance from the rogued planting except when leaf curl is presen. The frequent occurrence of winged forms of *Aphis rubiphila* makes it advisable to burn all plants infected with leaf curl. The danger of direct distribution of aphids from an infected planting to a healthy planting should not be overlooked. Aphids are easily carried from one planting to another on the clothes of berry pickers and other workers.

In Minnesota the production of the leading variety of red raspberry, the Latham, will be approximately 4,000,000 certified plants this year. The amount of infection found in the rogued plantings of this variety has steadily declined until it now averages less than one-half of one per cent for the 300 acres rogued this year. A disease-free zone of not less than 100 yards is maintained around each certified planting. Growers have found it difficult to produce clean stock in any district where they are surrounded by many infected plantings, even though a disease-free zone of 100 yards is maintained. This indicates that 100 yards is not sufficient under such conditions.

New York was the first state to enact a quarantine on account of raspberry mosaic and to establish special regulations covering the inspection and certification of raspberry plants. This quarantine was enacted on May 7, 1923. Since that time most of the states in the important raspberry growing sections have devoted special attention to the inspection of raspberry plants. On March 3, 1928, the Central Plant Board, representing thirteen states, adopted recommendations for the uniform inspection and certification of raspberry plants. These

recommendations include all virus diseases except mild mosaic. Briefly, they provide for two annual inspections, the eradication of all visibly infected plants, and a disease-free zone of 15 rods around each certified planting.

The inspection and certification of raspberry plants for virus diseases is not yet standardized in the various states to the same extent as for most of our insect pests and plant diseases. For this reason New York, Michigan, Minnesota, and Wisconsin have found it advisable to enact special regulations concerning the entry of raspberry plants. These regulations are substantially alike except that Michigan does not require a disease-free zone around each certified planting and includes mild mosaic, which is excluded by the other states.

There is every reason to believe that virus diseases cause tremendous losses to the bramble fruit industry of the country. Fortunately, conditions seem more favorable for combating this type of disease in the bramble fruits than in many other agricultural crops. It is known that disease-free plantings can be maintained for the production of plants. The insect vectors are not general feeders and their feeding range is restricted to the bramble fruits. When clean planting stock is used, the probability of serious injury from virus diseases is comparatively slight during the normal productive life of a planting. For these reasons the proper inspection and certification of raspberry plants is extremely important.

Owing to the general prevalence of these diseases it is questionable whether quarantines should be necessary to regulate the interstate movement of raspberry plants. Fundamentally, there is no more reason for such action than there would be to enact quarantines for many widely distributed and destructive pests with which nursery stock may become infested. This problem should become a part of the general movement for greater uniformity in methods of inspection rather than a problem concerning quarantine action.

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Chairman McLaine: We will next pass on to the paper by W. H. Larrimer and G. I. Reeves.

THE ALFALFA WEEVIL IN ALFALFA MEAL

By W. H. LARRIMER and GEORGE I. REEVES, *U. S. Bureau of Entomology*

ABSTRACT

The spread of the alfalfa weevil through the medium of alfalfa hay and meal has been studied throughout a period of thirteen months. The conclusion is drawn that the large number of weevils present in the growing crop diminishes with each step in the handling of the hay so that the accumulation on the premises of an alfalfa meal mill, even at the end of the summer, is negligible, and the only source of contamination in the mills, generally speaking, is the hay which is being ground. In certain mills whose product was accepted by quarantine officers for interstate shipment, it was possible for weevils to pass through the machine alive, but this condition was easily remedied, so that meal could be delivered uninfested at the door of the freight car.

Cars which have been used for infested alfalfa hay, however, remain infested for an indefinite time thereafter and are used more frequently for other commodities than for alfalfa meal. These cars move rapidly and in large numbers into every part of the United States and it is they, and not the alfalfa meal, which constitute the real danger.

During the 15 years that the alfalfa weevil has been known to inhabit America it has been the subject of a great variety of interstate quarantines arising from the general desire to prevent its spread. These quarantines have at times caused much dissatisfaction among commercial interests and some of the more annoying and less defensible provisions have consequently been modified, but there has been no general revision of them based upon thorough-going research. It is obvious that such quarantines should be limited to the movement of articles that are known to be concerned in the spread of the weevil.

One of the regulations which has been modified is that governing the movement of alfalfa meal. This product was formerly barred from shipment into uninfested territory because of the feeling that the large number of weevils known to be present in infested fields must in some way persist in the hay after it has been chopped. Later, because of the belief that the chopper in some way destroyed all the weevils which were put into it, meal was admitted to shipment during the winter months, from November to March inclusive. It was still barred during the rest of the year on the assumption that, during that time, weevils accumulated on the premises of alfalfa mills and could not be kept out of the finished meal.

Alfalfa meal is an especially suitable subject for investigation. It is a possible outlet for the reserve supply of winter forage which every livestock grower must provide and which, at the end of winter, he must market. Restricting its shipment places the alfalfa producer at the mercy of the local buyer.

The economic importance of the commodity is only one reason why

entomologists should examine the alfalfa meal embargo. It is typical of a class of quarantines which were instituted at a time when there were no published data on the spread of the alfalfa weevil, and which have remained untouched by later research. It claims the authority of science but has never been subjected to scientific scrutiny. Prevention of the spread of the weevil is possibly the least important of its economic effects, but because it professes to prevent the spread of the weevil, and because of its undoubted commercial importance, there is ample occasion for inquiry by entomologists into its scientific premises.

The alfalfa weevil laboratory has studied the handling of alfalfa hay and meal for more than a year, beginning with the third crop of 1927 and continuing until December, 1928. Each step intervening between the growing of the crop and the delivery of the meal has been analyzed and its effect upon the weevils contained has been ascertained, not in the way habitual with quarantine inspectors who must inspect a large quantity of material in a short time, but minutely and exhaustively.

The number of weevils occurring in hay is so small that the deviation of samples from the average is great, and in figures dealing with the haying process, although the actual values are given, nothing beyond the preponderance of numbers at one stage or another should be inferred. In the case of weevils in baled hay and in meal grinders, the normal number is so small that, in order to draw any conclusions at all, weevils had to be artificially added; these figures therefore give only the relative numbers destroyed at various steps in the process. Wherever the presence or absence of weevils is the significant thing, as in the sacking rooms, railroad cars and platforms, the amount of time spent in the search is the proper basis for criticism.

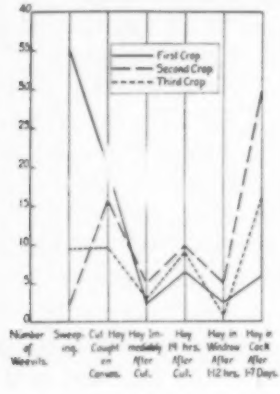

FIG. 26.—Adult Weevils in Unit Volume of Alfalfa in Successive Haying Operations.

Salt Lake and Weber Counties, Utah, and Churchill County, Nevada, were selected for the principal parts of the investigation because their fields were badly damaged and adjacent to meal mills whose product was admitted during the winter months to inter-state shipment.

The first figures to be presented deal with the number of weevils present in a quantity of standing alfalfa equivalent to 25 linear feet of swath, and with their disappearance and reappearance at the successive steps of harvesting and stacking.

While actual figures are given because of the prevalent misconception regarding the number of weevils occurring in infested hay, no inferences are drawn from them except that the beetles frequent the foliage early in the summer but prefer the ground later in the season, that the number found in hay is relatively small and that it increases whenever the hay lies on the ground and decreases when it is shaken.

This characteristic behaviour of the weevils could doubtless be turned to account, as, for example, by using a mechanical loader to take up the hay directly from the swath, thus eliminating the shocks in which weevils accumulate and reducing the numbers carried to the stack. But it is doubtful if anything would be gained, as nearly all the weevils which go into the stack, together with all the larvae and pupae, are killed, evidently by heat, starvation and pressure.

By the time the hay is broken out of the stack, the only surviving weevils are those which are sheltered in the litter at the base, and these are so few that in order to study the effect of baling the hay, it is necessary to introduce weevils artificially. In the present investigation this was done by sprinkling 1,000 weevils into each of three bales as the hay was fed into the press. Of these 3,000, 4.5% dropped out alive, and 1.5% dead, at once or within the first four days. After this, one bale was opened and thoroughly examined, the operation requiring three months, and the other two bales were kept under observation for a year. From the first bale 8.9% of the original 1,000 weevils were recovered alive, all within the first 60 days, and 29.2% were found dead; the remaining 55.9% were in fragments too small for detection. After the other two bales were segregated, 4.2% of the original 2,000 beetles issued alive, while 89.8% died within the bales. This high mortality takes place after the haying and stacking processes have already reduced the number of weevils to such an extent that it is impossible to find them.

The hay then arrives at a meal mill and is stored for a longer or shorter time upon the premises, after which it is ground. Quarantine officers have emphasized the possibility that weevils might accumulate about mills and find their way into sacks of clean meal; and they have assigned this as the reason for prohibiting the shipment of meal during the warmer months.

In order to study the occurrence of weevils in such places, a mill was selected at which chiefly loose hay was ground, thus eliminating the insecticidal effect of the baler. The search began in October, when the whole summer's accumulation was present, and during the month that it continued over 900 tons of hay passed through the mill. The most

skillful, careful and experienced member of the staff spent, during this time, 140 hours examining the walls, floor and litter of the mill and premises.

The total surface examined was 81,994 square feet and the quantity of chaff and similar litter minutely searched was 37,876 cubic inches. No weevils were found in the cyclone, sacking room or loading platform. Nineteen were found in the mill yard and five in the milling room —about one for each six hours of search. This disposes of the assumption that weevils collect in great numbers about mills; it is doubtful if any freight station in the infested territory has so few weevils on its premises.

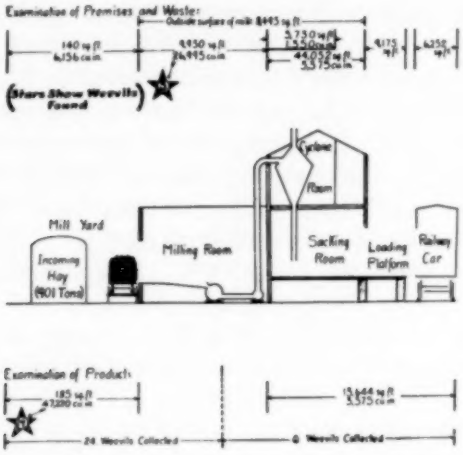

FIG. 27.—Distribution of Living Alfalfa Weevils at Meal Mill Grinding Loose Hay.

Even this small number is a menace if there is a possibility of these weevils passing alive through the mill. Thirty-seven hundred weevils were therefore fed through two mills, one of the chopper type and one of the hammer type. The meal containing the weevils was caught directly at the outlet of the elevator fan, in order to ensure recovering all the weevils without the labor of searching through the meal for small fragments. All the parts of each mill were tested separately to learn their effect upon the weevils, and it was found that in the hammer type of mill the grinder itself kills them, but the fan does not always do so; while in the chopper type not the grinder but the fan when driven at full speed gives a product free from weevils. Both grinder and fan must operate and the fan must be driven at full speed. The manager of the chopper mill in which the experiments were performed was so much impressed by the results that he installed a direct-connected motor to

drive the fan independently of the grinder, and preclude any trouble from the slipping of the belt.

After the meal leaves the fan, it moves through tightly-closed pipes and chambers to the sacking-room, and only a weevil-proof partition between the milling and sacking rooms is needed to prevent contamination and place the meal on the same footing, as regards carrying weevils, with other commodities, handled in other kinds of warehouses.

Alfalfa meal free from weevils is thus easily obtained, and easily provided with new or fumigated sacks. It differs in no respect from ordinary merchandise.

The freight cars from which baled hay was unloaded at alfalfa meal mills were carefully examined, after being "cleaned out" preparatory to their return to service. Over 50% of those which had been loaded with hay baled from the shock, as well as nearly 40% of those which had carried hay baled from the stack, contained living weevils. One car contained 66. Twenty of these cars were re-examined in the freight yards three miles distant several days later, after they had been returned to the railroad company. Eight of these which had had the weevils replaced after the original examination were found to contain weevils—two of them, more the second time than the first.

In view of these facts, and of the limited time available for the examination of any one car, it is probable that all cars which have carried alfalfa hay grown in Utah, Idaho, Nevada, eastern Oregon, southern Wyoming, western Colorado and parts of eastern California contain living alfalfa weevils for an indefinite time thereafter, both in winter and in summer.

Six hundred and twenty carloads of hay arrived at Ogden, Utah, during the first 11 months of 1928. Only a few of these were reloaded with alfalfa meal. Some of them were used again for short trips with alfalfa hay. Many were used for local freight of various kinds. Automobile cars and most foreign-line cars went east pursuant to standing orders. Several were traced to New York, Omaha, Los Angeles and Portland. Cars not subject to prompt return drifted with the regional movement, which at the season of most of these examinations was toward the lumber mills of the Pacific Northwest. Several of these again carried hay for longer or shorter distances en route.

Only a small percentage of the weevil-infested cars is loaded with alfalfa meal. Most of those which leave the weevil territory carry other, and unsuspected, merchandise.

CHAIRMAN MCLAINE: We will pass to the paper by Professor McCubbin.

POTATO WART

By W. A. McCUBBIN, *Bureau of Plant Industry, Harrisburg, Pa.*

ABSTRACT

Potato wart, which was discovered in Europe slightly before 1900, has been spreading rapidly there since that time, and was introduced to the United States probably about 1912. It is now known to be present in over 800 gardens in over 60 towns and villages in Pennsylvania, Maryland and West Virginia. All but 4 of these villages are in the mining districts of Pennsylvania. Quarantines in effect in these three states since 1918 aim to prevent all movement of potatoes or other material capable of carrying infection, and so far these quarantines appear to have been successful in preventing spread. Natural isolation of the mining communities and potato production below local needs have favored quarantine success. The totally immune Spaulding Rose is the only potato variety permitted in the areas under quarantine.

Whether or not wart can be exterminated eventually depends largely on the accuracy of early surveys; if these have not been complete, undiscovered areas may now be spreading infection to such an extent that final success may never be attained; if the wart is all confined in present quarantine areas it is possible to exterminate it either by soil sterilization methods or by a starvation process. The latter method is being followed as being less expensive and more consistent with the doubtful status of the survey. The Pennsylvania Department of Agriculture is investigating the longevity of the wart organism in the soil and the relation of the tomato to this disease.

Potato wart was unknown or at least unrecognized during the first century and a half of potato culture in Europe. Early records of its occurrence there are obscure but it was probably not widespread in any European country much before 1900. Since its recognition in 1896 it has been spreading rapidly in Europe and is also known to have entered Newfoundland, Canada and South Africa, as well as into our own country.

The wart disease was probably brought to this country about the year 1912 in shiploads of European potatoes which were known to have been imported at that time on account of a temporary crop shortage here. Certainly it could not have been introduced on any large scale since that date for in the fall of 1912 a Federal embargo was placed on potatoes from abroad on account of this disease.

It was hoped that the embargo would effectively prevent the introduction of wart to America and indeed up until 1918 there was every reason to think that the disease had been entirely excluded. In that year a case of wart was discovered in the hard coal districts of Pennsylvania and hurried surveys indicated that it was present in a number of other places in that area as well as in certain of the soft coal mining towns in the western part of the state. Surveys made since that time

have established the presence of wart in three states: Pennsylvania, where it has been found in 813 gardens in 58 towns and villages in 11 counties; West Virginia, which has two centers of infection; and Maryland, in which likewise two infection points occur. In spite of the probable wide distribution of the original potato shipments no cases of wart have cropped up elsewhere in the country in the intervening ten years.

This disease, caused by a fungus of one of the more primitive types (*Chrysophlyctis endobiotica* Schilb.) attacks those parts of the potato plant under or near the ground bringing about a pronounced development of gall tissue. The masses of wart tissue which thus arise from tubers and stolons are not unlike a cauliflower in general appearance. The warted mass may be so small that it is recognized with difficulty or it may be three inches or more in diameter. Since the hypertrophied tissues are not covered by the usual corky skin of the potato the gall-like masses decay very soon thus liberating the multitudes of spores which are borne in sporangia in the surface layer. There are two types of spores, those which germinate immediately and which may thus cause reinfections the same season, and a more resistant type which serves as a resting spore and which may remain alive in the soil for many years.

The host relationships of the wart fungus are puzzling. It is known to occur on the tomato to a small extent but has not been found naturally on any other plant even among the numerous species of the Solanaceae to which both tomato and potato belong. Even in the case of the potato parasitism is erratic; certain varieties such as the Rural New Yorker and Bliss Triumph are very susceptible yet other types may be grown in the worst infested soil without showing a trace of the disease. Among the common American varieties which are thus immune may be listed the Irish Cobbler, Green Mountain, Spaulding Rose, McCormick and Russet Burbank. Such complete immunity as is known to exist in these varieties is rare in the field of plant disease.

Since the wart organism is closely bound up with the soil and is not likely to be carried in wind or above ground plant parts it may effectively be prevented from spreading from place to place by a quarantine which stops the shipment of potatoes, root vegetables, plants with soil about their roots, manure, soil itself and such other materials as might become contaminated. The quarantines in effect from the discovery of the disease in each of the three states mentioned aim to stop all movement of spore bearing materials, and so far as present knowledge goes they appear to have been completely successful in keeping the disease within its original bounds.

The quarantine in force in Pennsylvania attempts to bottle up the disease by various means; railroad and express offices will accept no shipments of potatoes and will not forward consignments of miscellaneous nature such as household foods unless accompanied by certificate from the wart inspection service; the coal companies cooperate by notifying us of the removal of tenants from company owned houses; moving and trucking firms also work with us in this respect; and manure from those mines which are regarded as safe is allowed to go only into the neighboring valleys in the safety zone and then only with a permit accompanying every load.

A safety zone around the principal area of wart infection comprises several agricultural valleys in which no wart has ever been found but which have been more or less exposed to infection. All potatoes are grown in this zone under permit and where susceptible varieties are planted they are inspected in the growing season and all tuber shipments outward are likewise examined.

Within the areas actually under quarantine only a specified immune variety, the Spaulding Rose, is permitted and the seed used must be from an authorized source to avoid susceptible mixtures. The seed, usually obtained in Maine, is brought in by a local wholesale house, and distributed under State supervision largely through the coal company retail stores. Potato growers are encouraged to save their own seed from year to year.

That these quarantines have been outstanding for their success in a field where failure is almost the rule, is largely the result of fortunate circumstances. In practically all cases wart has been found in the mountain villages which are well isolated by waste land from agricultural areas; the drainage from these, in Pennsylvania at least, is into streams which are highly sulfurized from coal washings, and in consequence possess antiseptic qualities; and these towns and villages are consuming rather than producing centers. One might speak of the potato "pressure" as negative; the natural movement of potatoes is always inward.

Why the wart disease has so far shown up only in these mountain districts is still unknown. The original shipments of potatoes were spread far and wide but no wart has ever appeared at low altitudes where higher summer temperatures prevail. One may suspect that this disease, like the once dreaded powdery scab, can maintain itself only within certain climatic limitations; but the studies made on the response of the organism to temperature and moisture conditions give no hint

of such relationships, and no one yet has had the hardihood to make actual tests of its ability to survive in warmer and drier regions.

What is the probable future of the wart disease in this country? Is it established here as a permanent immigrant which in the course of time will spread as it has done in Europe, until the gradual infestation of our great potato producing areas compel us to change over to the immune varieties which are so fortunately available? Or, can we by reasonable expenditure of money and effort confine the intruder to its present limits and perhaps even eradicate it entirely? It would seem that if this latter object can be attained the nation would be much better off than if the disease is allowed to spread and we are compelled to go through a long and irritating and costly process of developing and adapting immune varieties to the needs of our varying potato areas. It is fairly obvious, too, that the spread of wart would be accompanied by a flock of quarantines most disturbing to the potato industry in various states.

In looking toward a permanent restriction of potato wart we face three considerations of importance. The first concerns the completeness of the surveys already made; have we at this time all the wart in the country under the lock and key of quarantine? In the second place it may be asked how far we can depend on quarantines to keep it there. Finally, it must be apparent that since no quarantine can be expected to function perfectly forever, final victory is hardly to be expected without the assistance of eradication measures.

In regard to the first of these three points we are probably at this time too optimistic. The first wart surveys were made hurriedly with relatively few men covering large areas. However faithfully done, the negative report from such surveys cannot be considered final. Moreover surveys of this nature carried out in a single season would fail altogether to locate actual wart in gardens not planted to potatoes that year, in others where immunes had succeeded susceptible varieties, or even where a crop rotation had taken place.

It is true that a very intensive type of survey has been carried out in Pennsylvania since 1924. Each year a small additional portion of the area originally scouted is examined very thoroughly; no new cases were discovered in the course of this intensive survey until the year 1928 when infection was found in a few gardens in a single village in the soft coal area.

If the limitations for the first survey and the wide distribution of the European potatoes are considered along with this new case, and if one

remembers further that 58 villages and towns scattered over 11 counties contain over 800 warted gardens the chances are very small that all wart infection in the country has been located. Yet in the face of this evidence there is complacent acceptance of the original surveys as conclusive and the prevailing idea seems to be that that potato wart problem is now all but solved.

The second uncertain feature in the situation concerns the effectiveness of the various wart quarantines in preventing actual spread of the disease. While these quarantines cover in excellent fashion all the usual and regular movements of dangerous materials they are no more adequate than any other measure of this kind to take care of the irregular, secret, ignorant or wilful violations which in a teeming and unsympathetic population are a constant danger.

While the fortunate circumstances mentioned above have contributed much to the success of the quarantine up to the present, the danger of leakage is so great that it would be unwise to depend on the quarantine alone as a permanent check on this disease. Unless some method of eradication can be counted on to destroy the source of infection this quarantine is likely to fail eventually.

What then are the prospects for eradicating the wart organism from the soil of infested gardens?

Two courses suggest themselves. The first involves soil sterilization by chemical or other means, and the second would aim at starvation of the organism by eliminating its host for a period sufficiently long to outlast the viability of the spores in the soil.

Soil sterilization can be accomplished. Several treatments are known to be effective but since the area in Pennsylvania totals more than 100 acres not concentrated in one block but scattered over more than 800 garden plots in widely separated towns and villages where waste land, trees, walks, and fences have to be considered, the cost would be formidable. Then a program of eradication calls for 100% efficiency, a most difficult aim to reach in actual practice. Reinfections from streets, waste land, etc., have to be considered. And last but not least one cannot overlook the possible existence of infection in gardens heretofore regarded as clean; that is, wart had not been seen in them to date. Consequently, eradication measures would have to cover much larger areas than the land actually infested. Such additions would double or treble the soil treatment costs. Further there is doubt as to the wisdom of entering on a costly soil treatment program when our knowledge of the actual distribution of the disease was so uncertain. The outcome of

these deliberations has been that proposals for chemical or steam sterilization were shelved for the time being, until more reassuring survey results were obtained, and in the meantime attention was directed to a second possibility: Can we starve the organism out of the soil?

Since we possess in the totally immune Spaulding Rose a satisfactory substitute for the various susceptible types formerly grown, this variety has been the only one permitted in the areas under quarantine since 1920 in Pennsylvania. The Irish Cobbler and Green Mountain are likewise available for use in the warted gardens and since their immunity is likewise absolute no multiplication of the organism can take place even if these are grown. It would seem then that we have only to hold the quarantine, restrict the growing of potatoes to these varieties and wait for the wart to die out quietly and inexpensively.

There are three difficulties in the way. The first concerns varietal impurities in the seed used. Susceptible mixtures in seed may develop wart and thus give it a new lease of life. This difficulty is not insurmountable and has been well taken care of in Pennsylvania by cellar inspection of all seed followed by garden inspection of all potatoes before wart could develop. All non-immunes are religiouslv destroyed at this time.

The second difficulty concerns the longevity of the organism in the soil and even in the absence of any host. In 1928 a few susceptible potatoes were grown in a garden in which they had not been planted for nine years. There was abundance of wart. European tests of like nature indicate that this organism is extremely long-lived and it may be 20 years or more before the last remaining spores perish in the infested gardens and the soil is clean again. A study of the longevity of the organism in soil under different culture conditions is now being conducted on a 20 year basis by the Department of Agriculture of Pennsylvania.

The third obstacle is the tomato, a plant widely grown all through the affected sections. The tomato is not a danger from the point of view of spread and was at first thought to be almost unattacked bv wart. Closer examination has shown that under certain conditions tomatoes develop wart to an extent that brings them at once into prominence in this problem of eradication. Obviously it is of little value to exclude the potato and allow free use of another plant which mav be able to keep the organism alive in the soil for an indefinite period. Owing to the importance of the tomato from this viewpoint special attention is now being given to its relationship to the disease. Anv consideration

of a permanent policy of eradication must certainly give a prominent place to the tomato.

In conclusion it may be said that the potato wart quarantine has been remarkably successful; that while intensive yearly surveys are uncovering very few new cases of wart, there is no assurance that it has all been discovered; that cost and practical difficulties have directed attention from a policy of soil sterilization toward the possibility of eradication by starvation; and that the unusual persistence of the spores in the soil and the appearance of the tomato as an important host plant present difficulties which are likely to defer a successful outcome for at least another 20 years.

What are the ultimate chances of success? Shall we eventually win out and destroy this unwelcome foreign visitor or will it gain on us to such an extent that eradication is hopeless? The best that can be said at the present time is that no answer is possible until there is more definite assurance on the actual distribution of wart in the country. If one were to venture an opinion based on the areas now known to be infested our chances for ultimate victory might be estimated at about 50–50.

CHAIRMAN MCLAINE: I am afraid Professor McCubbin has not painted a very optimistic picture of the wart disease situation. I hope, however, that the 50–50 chances may be increased and that we may ultimately see the disease eradicated. We will call upon Professor Harned.

THE PRESENT STATUS OF THE SWEET POTATO WEEVIL IN THE UNITED STATES

By R. W. HARNED, *A. & M. College, Miss.*

At the present time, five states, Florida, Alabama, Mississippi, Louisiana and Texas are known to be infested with the sweet potato weevil, *Cylas formicarius*.

Only one other state, Georgia, is definitely known to have been infested in the past. Part of Charlton County, Georgia was found to be infested with the sweet potato weevil in 1917. This area joined an infested area in Baker County, Florida. A systematic campaign to completely eradicate the weevil from this Baker-Charlton area was inaugurated in 1917 by the United States Bureau of Entomology and the State Plant Board of Florida. The infested area included about 340 square miles and about 200 miles surrounding this area was considered as a "danger zone." In the survey of 1918, 1,185 properties were in-

spected. Weevils were found on 196 properties and 68 other properties were considered as probably infested. The number of infested properties in this Baker-Charlton area was reduced by years since 1918 from 196 to 90 to 65 to 44 to 13 to 1 in 1923. Since then no infested properties have been found. An interesting detailed report regarding this work by B. L. Boyden, Associate Entomologist of the United States Bureau of Entomology was published in the Monthly Bulletin of the State Plant Board of Florida for August 1927 under the title "Sweet Potato Weevil Eradication in Florida and Georgia." This is especially interesting as it shows that the most serious pest of the sweet potato was eradicated from a comparatively large area in six years by persistence and hard work.

The sweet potato weevil was first reported from Mississippi in the fall of 1917 by K. L. Cockerham of the U. S. Bureau of Entomology, who found 18 properties infested in Hancock County and three properties infested in Jackson County. The weevil had apparently been present in limited areas for several years—sometimes causing total loss in the fields of sweet potatoes. A systematic eradication campaign was commenced in 1918 by the U. S. Bureau of Entomology in cooperation with the State Plant Board of Mississippi. The entire state of Mississippi has since then been quite thoroughly scouted for the sweet potato weevil, and a total of 873 properties have been found infested. The weevils have apparently been eradicated from 772 of these properties leaving 101 properties infested in 1928. The following table shows the number of infested properties that have been found in each county and the number found infested during 1928.

County	Total properties infested 1917–1928	Properties infested in 1928
Adams	1	0
George	27	0
Hancock	145	13
Harrison	221	57
Jackson	349	17
Pearl River	130	14
Total	873	101

K. L. Cockerham, Associate Entomologist of the United States Bureau of Entomology with headquarters at Biloxi, Mississippi, who has charge of the sweet potato weevil work for the Bureau in both Alabama and

Mississippi reports on December 22, 1928 that no weevils have been found in Baldwin County, Alabama during 1928 although 70 properties have at one time or another in previous years been known to be infested in that county. In Mobile County where a total of 110 properties have been infested, only 17 infested properties were found during 1928.

The fine progress that has been made indicates that we might expect the complete eradication of the sweet potato weevil from Alabama and Mississippi within a few years. There remain the three most seriously infested states, Florida, Louisiana and Texas.

Although the sweet potato weevil had been found in only 21 of the 60 counties in Florida and some of these counties were only slightly infested and from one of them, Baker County, the weevils had apparently been completely eradicated, after enforcing quarantine measures for about ten years to protect the uninfested sections of the state, in July, 1927, the State Plant Board of Florida revoked all of their quarantine regulations relating to the sweet potato weevil.

In a letter regarding the repeal of the sweet potato weevil quarantine, J. H. Montgomery, Quarantine Inspector of Florida wrote as follows, on December 18, 1928:

"In so far as the sweet potato weevil situation here in Florida is concerned, we are convinced that quarantines are no longer justified, this conviction being based principally upon two things: (a) under present conditions the efficiency of the quarantine is greatly impaired; (b) the necessity for retarding the spread is not nearly as acute as it was prior to the development by the Bureau of Entomology of a practical means of producing a profitable crop of sweet potatoes even in the presence of the sweet potato weevil in the vicinity. With these two things in mind, the Plant Commissioner and his staff submitted a recommendation to the Board at its June meeting and the Board acted favorably thereon."

Probably less than one-third of the area of Louisiana is infested with the sweet potato weevil. According to State Entomologist W. E. Anderson, the weevils are only known to occur in 28 of the 64 parishes in Louisiana. The infested parishes are in the southern half of the state and are as follows: Acadia, Ascension, Assumption, Calcasieu, Cameron, Evangeline, Iberia, Iberville, Jefferson, Jefferson Davis, Lafayette Lafourche, Livingston, Orleans, Plaquemines, Pointe Coupee, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Landry, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, Vermilion, and West Baton Rouge. These parishes are within a quarantined area from which sweet potatoes and sweet potato plants cannot be moved until they have been inspected and found to be free of weevils.

Regarding the situation in Louisiana, Mr. Anderson wrote on December 17 as follows:

"In the balance of the parishes, we are reasonably sure that the weevil does not occur. At one time, an infestation was started around Shreveport, but subsequent inspections in that territory have all shown negative results. We are of the opinion that the weevil cannot stand the colder weather in the northern half of Louisiana. This is borne out more or less by its disappearance from Shreveport after one or two years."

Mr. Anderson considers the sweet potato weevil a very serious menace in the extreme southern portion of Louisiana, and hopes by the enforcement of the quarantine to create strong public sentiment for the eradication of the weevils by the growers themselves. He states that this system has apparently been successful in eradicating the weevils from Allen, Beauregard and East and West Feliciana parishes. No organized effort toward eradication, such as is being conducted in Alabama and Mississippi, is being attempted at present.

Regarding the situation in Texas, on December 11, 1928, Tom O'Neill, Assistant Entomologist, Austin, Texas, wrote:

"We consider all of south Texas to be infested, although there are in many counties isolated sections in the piney woods and newly cleared land in certain of the undeveloped sections that are still free from the weevil. Beginning on the Louisiana line in Orange County an approximate line of probable infestation would extend northwest through Tyler and Polk Counties; then southwest through Waller and Austin Counties, northwest including Travis County; thence through Blanco and Gillespie Counties to Kerr, and southwest including Uvalde, Zavalla and Maverick. In addition to this we have two heavily infested counties in our principal potato producing sections of northeast Texas; namely, Upshur and Gregg, and a newly infested county (Smith) adjoining.

In Upshur and Gregg counties, no form of control has been practiced and so far we have been unable to take any steps to eradicate the weevil in those counties. Infestation in Smith County was introduced in the winter of 1927 and vigorous eradication methods are being pursued. It is possible that no infestation will appear there the coming year. In the Gulf Coast Counties and inland for sometimes fifty or one hundred miles and in the section of the State south and southwest of San Antonio the weevil is apparently permanently established. I have found it in the roots of the tievine, *Ipomoea trifida*, and one other undetermined Ipomoea, in a few instances as far as four or five miles from any previous

potato crop. It is, of course, impossible to starve out the weevil when these weeds are generally prevalent over a section, and we are not attempting any control in this part of the State.

As to the western limits of infestation, they follow the western limits of sweet potato cultivation in south Texas. About 1924 there was infestation discovered in Presidio County in the Big Bend Section, but the weevil there was promptly eradicated and repeated subsequent inspections have shown no infestation. No infestation has been discovered in El Paso County, although a fair amount of potatoes are grown on the irrigated lands there. [Reports from Portales, N. M., a large potato growing center, show no infestation], and I believe that New Mexico, Arizona and California are free from the weevil.

Prior to 1927 when our inspection law went into effect, the sweet potato weevil might be found almost anywhere in Texas, due to the unrestricted shipment of plants from south Texas. Since freezing temperatures seldom occur in south Texas, the common practice had been to pull the volunteer plants early in the spring and ship them all over the State. Very few potatoes were bedded and the bulk of all plants used were these early volunteer plants from the South which sold at such a low price that growers who stored and bedded seed could not compete. This practice was prevalent for a number of years, and surveys by the Federal Government about 1920 showed about ninety Texas counties to be infested, many of these being in east and northeast Texas.

Since 1924 repeated inspections in north and east Texas have failed to disclose any infestation except in the three counties mentioned above. In a few of these counties we have records of the eradication of the weevil by the burning of infested crops in the fields. A greater number, however, have undoubtedly frozen out as farms definitely known to have been infested as late as 1926 have been repeatedly inspected and found free from the weevil. Infestation has continued in Upshur and Gregg counties by the practice of storing weevily potatoes and later planting these out and furnishing slips either free or very cheaply to contract farmers, who later sell their crop back to the storage houses. It has been our experience, especially well demonstrated in Texas in 1927, that the weevil cannot live in north Texas over the winter unless protected. In Smith County several heavily infested farms were examined in January and all the numerous weevils found in the field were dead. Live weevils were found in storage houses and dumps, but when called to the attention of the owners such potatoes were destroyed.

As to the seriousness of the sweet potato weevil, we consider it the most important potato pest in the State. We know of several instances where it has caused communities to cease growing sweet potatoes and abandon their storage houses. Communities south of San Antonio that formerly shipped many cars of sweet potatoes each year now raise only a few in home gardens. Certain merchants in south Texas have told me that they do not handle local potatoes on account of the weevil but import their potatoes from east Texas."

There is no federal quarantine relating to the sweet potato weevil. The 14 states that have quarantines to protect themselves from this insect are Alabama, Arkansas, Arizona, California, Georgia, Louisiana, Missouri (?) North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. Some of these quarantines specify the particular states or parts of states that are quarantined. Other states require that each shipment be certified.

Although it has long been known that the sweet potato weevil is able to fly, it has generally been thought that it uses its wings but little. There is little evidence to indicate that new areas have become infested by weevils flying to them. Recently, however, K. L. Cockerham and his associates on the Gulf Coast have collected a few weevils in light traps at night.

Changed conditions brought about by good roads and automobiles have greatly increased the difficulties of all quarantines and have multiplied chances of further spread of the sweet potato weevil.

CHAIRMAN MCLAINE: I will call on Mr. Sasscer for his paper.

RECENT INTERCEPTIONS OF PLANT PESTS

By E. R. SASSCER, *Washington, D. C.*

(Withdrawn for publication elsewhere.)

CHAIRMAN MCLAINE: It is a very formidable list of names of pests and diseases that certainly cause us a great deal of concern. We are all faced with the same problem, we in Canada, too, but on account of our climatic conditions, we are not faced with as serious a situation as you are here.

CHAIRMAN MCLAINE: The next business is the report of the Resolutions Committee.

MR. F. N. WALLACE: Mr. Chairman, the Chairman of the Resolutions Committee has disappeared but Mr. Faxon and I have drawn up a few resolutions, as follows:

REPORT OF THE RESOLUTIONS COMMITTEE

I *Resolved*, That this body heartily endorses Dr. Headlee's suggestion that ample funds be made available for research in problems relating to plant quarantines and

II WHEREAS, The great majority of the public seldom, if ever, have any contact with the quarantine officials and are not familiar with the work; many being in complete ignorance of the purposes of road patrols; therefore, we believe the road guard personnel who are local men and on whom the success of the quarantine operation depends, should be given a period of training prior to contacting the public, so that they may be more familiar with their duties and more intelligently answer questions regarding the work, and

III WHEREAS, This body recognizes the danger to American agriculture by the unrestricted introduction of diseases of plants which are being brought into this country for study by various institutions, organizations and individuals, and therefore urges that appropriate action be taken to secure the legislation necessary to regulate the introduction of plant diseases as such and suggests that such legislation be similar to that governing the introduction or interstate movement of living insects."

CHAIRMAN MCLAINE: Gentlemen, you have heard the report of the Resolutions Committee. What is your wish in regard to that? They were moved and adopted.

CHAIRMAN MCLAINE: We now have the report of the Nominations Committee Professor Harned!

MR. R. W. HARNED: The report of the Committee on Nominations of the Section of Plant Quarantine and Inspection is as follows:

For Chairman for next year, F. N. Wallance, of Indianapolis; for Secretary, S. B. Fracker, of Washington, D. C.

Respectfully submitted,

R. W. HARNED
E. R. SASSCER
E. N. CORY

CHAIRMAN MCLAINE: Gentlemen, you have heard the report of the Nominations Committee. What is your wish with regard to this report?

Mr. E. N. CORY: I move the Secretary cast a unanimous ballot for the nominees. The motion was seconded, put to a vote and carried.

The meeting adjourned at five twenty-five o'clock

Section of Apiculture

Saturday Morning December 29, 1928

ADDRESS OF CHAIRMAN OF APICULTURAL SECTION

By H. F. WILSON, *Madison, Wisc.*

ABSTRACT

Research in beekeeping is particularly important because the bee is the one insect in America from which we are able to secure a direct monetary return.

The most important research work that can be done in beekeeping today is along the line of the study of honey. We do not have a very thorough knowledge of honey, and this knowledge is necessary in selling honey to the consumer.

This paper may sound like it had been prepared for a marketing conference, but I believe that it is permissible for me to touch upon the commercial phases of the bee industry in connection with needed research, which I feel is more important to the beekeeping industry at the present time than any other, and I hope it may have the effect of stimulating more research in beekeeping particularly with regard to honey values. Although, this is a meeting at which purely scientific papers are expected, it is barely possible that a paper with a little commercial aspect might be of considerable value in calling to the attention of our entomologists the possibility of beekeeping as a problem in economic entomology, that is worthy of their attention and one in which there is great opportunity for profitable research.

We are, of course, quite definite in our knowledge that the honey bee is an insect, but we also know that only a comparatively few entomologists are actively interested in beekeeping and I sometimes wonder if beekeeping should not be distinctly separated from economic entomology. Perhaps it might receive better support in a Department of Animal Industry. But I question very much the desirability of having beekeeping in the Departments of Horticulture, as is now the case at the Michigan Agricultural College, and I believe that beekeeping is taught in the Horticultural Department at the University of New Hampshire. These incidents may be mentioned merely as an indication that the entomologists are neglecting what I feel is one of the important problems in economic entomology, and one that has great possibilities in nearly every state.

Economic entomology as a whole covers a vast field and the entire population of the world is more or less dependent upon its successful operation. All insects and the closely related forms which may be included in the field of economic entomology bring a continual threat to

all organic material—both living and dead. A continual warfare is being carried on to save our crops before and after they are harvested, to save our animals from destruction—and, although the insects which affect men directly are studied mostly by medical men, still, I believe that it remains a problem rightly belonging in the field of economic entomology. With this vast array dealing with 120 million people in the United States it is only reasonable to suppose that beekeeping would be a minor phase of economic entomology. But, still when we consider that it has been estimated that there are over 800,000 people in the United States who are keeping bees and that the value of the honey crop runs from 40 to 50 million dollars a year, beekeeping reaches a certain degree of importance.

Beekeeping is particularly important because the bee is the one insect in America from which we are able to secure a direct monetary return. It destroys nothing, yet produces an economic return of inestimable value. As a matter of fact, it is possible to give figures only on a small part of the return made by the honey bee. For, unfortunately, we cannot accurately estimate the indirect returns received from the pollination of fruits and of various garden and field crops.

In addition to these facts a further income is derived from it by those people who are engaged in the manufacture of bee supplies and in producing queens and package bees. There are many individuals in the United States and Canada whose entire income is derived from bees and there are thousands of farmers whose income is considerably supplemented by the returns from the annual honey crop.

Of course, we must not over-look the many people who are keeping bees and who do not secure a sufficient return to pay them for the money invested in equipment, nor the time spent in attempting to produce a crop. Yet, I do not believe that we should in any way consider this the fault of the bees, for it is entirely due to improper care of them or poor business methods in disposing of the honey crop.

I do not believe that anyone would attempt to say that beekeeping is not commercially successful for it is today considered one of our commercial agricultural industries. Of course, we seem to be having a great deal of difficulty just at the present time because of a lack of organization among the beekeepers and a depression in the honey market. However, I believe that if we stop to analize the situation, we will be forced to realize that the beekeeping industry has been making continuous progress and the reason why it seems backward in its development is because we attempt to compare it with industries outside the

field of Agriculture. Honey is in no different position than most all other phases of Agriculture in which there can be easily created a greater supply than any present demand, but the farming industry must be made to succeed, and as the various phases of farm industry become more successful, it will help other phases in which may be included the honey industry. I believe that beekeeping has splendid prospects for the future—like farming, it lacks leadership, and leadership in any financial industry will not function very far without an economic return, which in general may be considered a monetary return. As the beekeeping industry develops and the opportunity for the investment of capitol is created, beekeeping will become more profitable and therefore more successful. Perhaps some of you already know that there is at the present time a considerable amount of talk concerning the possible use of honey in the place of glycerine in the manufacture of certain products in which glycerine forms an important part. For example—I have been told that the Colgate Company is now trying out the use of honey in the place of glycerine in one of their shaving soaps. It is also known that a large company with heavy financial backing has organized a company under the name of "Preserves & Honey, Inc." This company has taken over four or five of the large bottling concerns, including that of the A. I. Root Company and will try to market honey in a large business way. This indicates that capital is being attracted by the possibilities of honey and let us hope that this venture is a step that will bring progress in the future marketing of honey. All of us at times become discouraged over the situation and while I doubt very much the possibility of carrying on at the present time a national organization of beekeepers, still we cannot overlook the progress that has been made, and we must continue. I believe that the greatest difficulty with the beekeeping industry today is the lack of knowledge concerning honey. Hundreds of volumes have been written about bees and about beekeeping methods—actually very little of this material contains any important research. Much time has been devoted to the study of the bee and the improvement of beekeeping methods, but practically nothing has been done in the study of the product. A great deal has been said with regard to the food and health value of honey but these discussions have not been based on any great amount of experimental evidence. A part of the so-called research done with honey has, I think been more detrimental than beneficial. I am thinking particularly of the attitude now held by most of our workers in Home Economics. Knowing nothing about honey, they use

sugar for a comparison and quickly come to the decision that sugar being cheaper and the knowledge of its use being widespread, further research with honey is unnecessary. The honey salesman knows practically nothing about honey and so we find honey mostly considered as a table delicacy whose only unusual property is its slightly different appearance and flavor compared with a host of other food products.

I believe that the most important research work that can be done for the beekeeping industry today is with the product itself. With the continual struggle that is being made to provide new food products having an appeal which will sell them to the public, our difficulties become greater. And, unless we can find that honey has one or more particular economic values, either as a health food or in the manufacture of certain other products, or, if we cannot find some valuable bi-products in honey, beekeeping as a commercial enterprise is in a dangerous position. Research along the lines of bee behavior and beekeeping methods is scientifically interesting and the different points now being determined may be of considerable value at a later date, but it is so easy at the present time to produce more honey than the market will take care of that it seems to me that all of us who are interested in the development of beekeeping might find better values if we spend our time in trying to create a better knowledge of the physical and chemical values of honey. In this connection I believe we should make a combined effort to aid the Bee Culture Laboratory at Washington in securing funds for this purpose.

E. F. PHILLIPS: The Chairman has called attention to some highly important phases of the work of promoting beekeeping. It may be well to call attention to one difficulty which is constantly encountered in this effort. Most of the men who are working in the several colleges and universities and in the federal Bureau of Entomology are trained primarily in biological work. Beekeeping includes not only the biological phases and the practical applications of such work in the development of proper methods of beekeeping practice, but it also includes the economic phases which find their place in the distribution of honey to the consumer. It is, of course, unwise and unsafe for a biologist to extend himself into these fields for which he is not trained, and where this has been done, it usually adds little to the benefits to beekeepers. It seems important that we enlist in this effort those men of the various institutions whose training fits them for a proper attack on the economic problems of honey and in other lines of scientific effort such as the chemistry and nutritional value of this product.

It is of course obvious that the Chairman is entirely correct in his emphasis of honey in the plans for the development of beekeeping.

ON THE OCCURRENCE OF THE YEASTS WHICH MAY CAUSE THE SPOILAGE OF HONEY

H. F. WILSON and G. E. MARVIN, *Madison, Wisc.*

A preliminary report on the yeasts found in honey shows that yeasts capable of fermenting an 80% solution of honey can be found on all parts of the bee and in the honey sack. Also, that similar yeasts occur in the pollen stored within the hive and that a single yeast capable of fermenting honey has been taken from the skin of grape. Attempts to find these yeasts on other fruits were unsuccessful.

During the course of our investigations on the cause of spoilage of honey, a previous report of which has been given by Mr. Marvin in this JOURNAL (Vol. 21, part 2, pp. 363–370, 1928), we were led to wonder just how yeasts find their way into honey. From other experiments which are in progress, it seems quite apparent that there are spores of these yeasts which may remain in honey for a considerable period of time and when the right conditions develop, the spores germinate and active fermentation takes place. With this in mind, we have made a few preliminary investigations to determine the occurrence of these yeasts, and the results are reported in this paper.

This report is a preliminary report only, and is for the purpose of calling attention to the source of yeasts which may occur in honey, and which are likely to cause spoilage. We have found these yeasts in fresh pollen taken from the legs of incoming bees, in pollen taken from the hive, and on the tongue, legs and within the honey sac of bees. In a study of the yeasts from fruits, we have also found one yeast on grapes which is able to ferment an 80% honey solution. The identification of these yeasts will require much study, and, although we appear to have many different types, they can probably be classified in a few groups.

MATERIALS

Two kinds of satisfactory media have been worked out for the study of yeasts in honey. The ordinary culture media used for plating and slants is made of 1,000 c.c.'s of sterile yeast water, 200 c.c.'s of honey and 36 grams of agar. A second media consists of a 50% honey solution, made by adding equal parts of water and honey. This last media has been particularly useful, because it is possible to eliminate molds and the yeasts which do not ferment high concentrations of sugar.

THE EXPERIMENTS

TEST I. Pollen was removed from the legs of six incoming bees. The pollen from one series of legs was broken up and poured into sterile petri dishes. The six masses from the opposite legs were put into tubes

of sterile 50% honey. These were then set aside at room temperature to incubate. Within a week, yeast colonies began to appear in the petri dishes, and about the same time the tubes of honey began to show signs of fermentation. In plating pollen directly as we did, a great many molds appeared on the plate which interfered with our work. We noticed that by first putting the pollen in the diluted honey and plating from it after fermentation had started that we were able to avoid the troublesome molds. In picking colonies, isolated ones were taken. In studying the gross appearance of the colonies on the petri dishes, it appeared as if there were six different types.

TABLE 1.

			Xylose	Glucose	Galactose	Mannose	Levulose	Sucrose	Maltose	Lactose	Raffinose	Melizetose	Starch	Dextrin
Apiary	1	20A	–	x	–	x	x	x	–	–	–	–	–	–
	2	20B	–	x	–	x	x	x	x	–	–	x	–	–
Grape	3	21	–	x	–	x	x	x	–	–	–	x	–	–
Legs	4	13A	–	x	–	x	x	x	x	–	–	x	–	–
Tongue	5	15A	–	x	–	x	x	x	–	–	–	–	–	–
	6	15B	–	x	–	x	x	x	–	–	–	x	–	–
	7	12A	–	x	x	x	x	x	x	–	x	–	–	–
	8	12E	–	x	x	x	x	x	x	x	x	–	–	–
Sac	9	18A	–	x	–	x	x	x	–	–	–	x	–	–
	10	18C	–	x	–	x	x	x	x	–	–	x	–	–
	11	17	–	x	x	x	x	x	x	–	–	x	–	–
Pollen	12	10A	–	x	–	x	x	x	x	–	–	x	–	–
	13	10B	–	x	–	x	x	x	–	–	–	–	–	–
	14	10C	–	x	–	x	x	x	–	–	–	x	–	–
	15	10D	x	x	x	x	x	x	x	–	x	x	x	x
	16	11	–	x	–	x	x	x	–	–	–	x	–	–
	17	19	–	x	–	x	x	x	–	–	–	–	–	–
Flowers	18	22A	–	x	–	x	x	x	x	–	–	–	–	–
	19	22B	–	x	–	x	x	x	x	x	x	x	x	x

On the occurrence of yeasts which may cause spoilage of honey and their actions on sugars, starch and dextrin.

"x" denotes the evolution of gas and surface or bottom growth.

TEST II. Masses of pollen were removed from cells within the combs taken from the hive. This was done with sterile forceps and plated. The yeasts from this source were very abundant, and what appear to be three different strains have been isolated. Since yeasts seem to be of value in the nutrition of animals, it is entirely possible that the yeasts in pollen and honey may be important in the nutrition of immature bees.

TABLE 2.

	Glucose	Galactose	Mannose	Levulose	Sucrose	Maltose	Lactose	Raffinose	Melezitose	Starch	Dextrin	Xylose
GROUP I.												
1 Apiary, 5 Tongue, 13 Pollen, 17 Pollen	x		x	x	x							
GROUP II.												
2 Apairy, 4 Legs, 10 Honey sac, 12 Pollen	x		x	x	x	x			x	.		
GROUP III.												
3 Grape, 6 Tongue, 9 Honey Sac, 14 Pollen, 16 Pollen	x		x	x	x				x			
GROUP IV.												
7 Tongue	x	x	x	x	x	x		x				
8 Tongue	x	x	x	x	x	x	x	x				
11 Honey Sac	x	x	x	x	x	x			x			
GROUP V.												
15 Pollen	x	x	x	x	x	x		x	x	x	x	x
19 Flower	x		x	x	x	x	x	x	x	x	x	

This table shows the grouping and sources of the yeasts.
"x" indicates the presence of gas, surface or bottom growth.

TEST III. Blossoms were removed from squash, dandelion and white clover, over which bees were observed to have crawled in search of nectar or pollen. The pistil of squash was removed with sterile forceps and plated directly. Within a week, two apparently different strains of yeast were isolated. The dandelion and clover blossoms were plucked in the field and immediately transferred to a 50% honey solution. Fermentation occurred in both cases.

TEST IV. Incoming bees without pollen were collected, and the honey sacs removed by the following method—Sterile forceps and scissors were used. The end of the abdomen was cut off just above the base of the sting. The thorax and the abdomen were then pulled apart, exposing the honey sac. The honey sac was removed and put into melted honey agar and broken open to allow the nectar present to spread in the agar. The agar was then poured into sterile petri dishes

and within five days yeast colonies developed. These were transferred to slopes and from gross appearance five different types of colonies were secured.

TEST V. Incoming bees were collected which did not appear to have any noticeable pollen on their hind legs. The hind legs from four bees were removed and plated on honey agar direct, and the four opposite legs placed in the 50% honey solution. What appeared to be three different types of yeasts have been isolated from the legs in this way.

TEST VI. Tongues from incoming bees were removed by sterile forceps and were both plated and put into dilute honey. The yeasts appeared to develop in both cases, and 6 apparently different yeasts were obtained from this source.

TABLE 3.

Source		Culture	50% Honey	80% Honey
Apiary	1	20A	x	x
	2	20B	x	x
Grape	3	21	x	x
Legs	4	13A	x	x
	5	13B	x	x
	6	13C	x	x
Tongue	7	15A	x	x
	8	15B	x	x
	9	12A	x	–
	10	12B	x	–
	11	12C	x	–
	12	12D	x	–
Honey Sacs	13	18A	x	x
	14	18B	x	x
	15	18C	x	–
	16	18D	x	–
	17	17	x	–
Pollen	18	10A	x	x
	19	10B	x	x
	20	10C	x	x
	21	10D	x	x
	22	11	x	x
	23	19	x	x
Flowers	24	22A	x	x
	25	22B	x	x

On the occurrence of yeasts which may cause the spoilage of honey and their actions on a 50% and 80% solution of honey.

"x" indicates that the yeasts fermented the solution.

Cultures of these yeasts are being continued and if satisfactory identifications can be secured descriptions with photographs will appear in a later publication.

TEST VII. Flasks of 50% honey solution were exposed in the following places:—

(a) two flasks in a nearby orchard
(b) two flasks in the honey laboratory
(c) two flasks in the basement of the laboratory
(d) two flasks in the classroom
(e) two flasks on a bee hive in the apiary

The first four series of flasks became covered with mold, but no active fermentation could be observed. The two flasks exposed in the bee yard showed active fermentation, and two types of yeast have been isolated from this source. This test was again tried with a triplicate series of flasks, and exactly the same results were obtained.

TEST VIII. Outer portions of apples, peaches and grapes were plated in sterile petri dishes. We expected to find yeasts from the three fruits, but if any were present on the apples and peaches, they did not grow on this media. Many colonies of yeasts developed from the grape inoculum, and all of the colonies from grapes appear to be the same. This one type has been proven capable of fermenting an 80% honey solution.

THE RESPIRATORY EXCHANGE OF THE HONEY BEE

By G. H. VANSELL, *Davis, Calif.*

Record of water and carbon dioxide production by a normal colony of bees has been made through many months, both winter and summer. These materials were collected by being absorbed in bulbs of absorbents while the air from the hive was being drawn through them. Definite volumes were measured by means of drip arrangements from carboys. A careful check was made (simultaneously) of the moisture and carbon dioxide in a volume of outside air equal to that drawn through the colony. By subtracting the amount of these substances in the air from the amount collected from the hive, that produced by the bees was obtained.

The average hourly discharge from the hive of water and carbon dioxide during winter was *1.3 mg.* and *17.6 mg.* respectively. During summer, when nectar was coming in, the amounts were *30.8 mg.* and *25.2 mg.* per hour. Weight records and temperature records of the cluster and other parts of the hive were made in connection with the respiratory work and, as was expected, direct correlation usually occurred

in winter between loss in weight cluster temperatures, and production of carbon dioxide. Often during winter, however, the amount of moisture in the colony air was less than that in the air outside which seems to indicate that the bees or stores were absorbing atmospheric moisture.

No measurements on the respiratory exchange of the individual bees have been taken as yet.

A STUDY OF THE FACTORS INFLUENCING THE YIELD OF HONEY DURING THE MAIN NECTAR FLOW

By J. A. MUNRO, *Entomologist, North Dakota Experiment Station, Fargo, North Dakota*

ABSTRACT

In addition to recording the daily changes in weight of a hive of bees on scales, beekeepers should also secure a daily record of weather data provided the Weather Bureau is not too far distant to be applicable. With these two sets of records the beekeeper will be better able to learn the factors which influence the yield of honey. A study of weather data and record of a hive of bees on scales, at the North Dakota Experiment Station, indicated that excessive rainfall, during the normal nectar flow period, was more responsible for decreased yield of honey than any other cause.

For North Dakota and to a large extent throughout the Great Plains region, where sweet clover is the main nectar yielder for surplus honey production, the months of July and August may be considered as the main nectar flow period.

Properly cared for colonies make the most rapid and appreciable gains in hive weight during those months. It is then that the important nectar yielding plants are in bloom to the fullest extent and most colonies are in proper condition for gathering.

In this study several factors have been briefly considered in their relation to the amount of honey produced by a hive of bees on scales. Although the amount of data on hand might justify the working out of correlation figures, practically nothing has been done in that direction. This paper includes only a review of the main factors as probably affecting the colony on scales, together with observations made and conclusions drawn.

In a study of this kind there are in general two main types of factors to be considered. The factors which belong to "weather" include rainfall or precipitation, the amount of sunshine, temperatures, wind direction and velocity and so on; all of which could not be conveniently considered in a brief paper at this time. The factors included under weather may be considered as variable or fluctuating. Factors which have to do

North Dakota Experiment Station Apiary

with the bees, their condition, the nectar yielding plants and the soil on which they are grown may for all practical purposes in this study be considered as fairly constant.

During the seasons of 1927 and 1928 daily weights were recorded of a hive of bees on scales in the experiment station apiary at Fargo, North Dakota. Each season the colony selected for this purpose was normal and apparently of average strength as compared with the other colonies in the apiary. Except for daily weight readings, the scale colony was given the same care and attention as the rest of the hives in the yard. All colonies were provided with supers for storage as needed and aside from that very little care was necessary. So far as could be ascertained no swarming occurred during either season.

The type of soil in the vicinity of the apiary and for a radius of several miles included the Fargo Silty Clay, Fargo Clay and Fargo Clay Alkali phase, upon all of which sweet clover thrives and grows well. Most of the acreage of this plant, available to the bees, was situated to the West of the apiary on the Fargo Clay Alkali phase type of soil.

For the size of the apiary there was abundance of sweet clover and other bloom, throughout each of the seasons, within range of bee-flight.

Weather data were secured from the United States Weather Bureau, Moorhead, Minnesota. This Station is located approximately two and one-half miles from the apiary in which the scale colony was situated. Since this Station might be included in the range flight of the scale colony of bees, the weather data can be regarded as satisfactorily representing the weather conditions as existing in the apiary.

Briefly, the July-August period of 1927 was favorable for honey production. The total rainfall or precipitation for those two months amounted to 3.03 inches; of this, 1.01 inches fell during July and the balance of 2.02 inches was recorded for August. The net gain in weight of the scale hive of bees for that period was 330 pounds; of this, 168¾ pounds was recorded for July and the balance of 161¼ pounds for August. Reference to the sunshine data for those months show that for July 1927 there was only 80% of possible sunshine or a total of 381.6 hours of sunshine for the 31 day period. August showed 82% of possible sunshine or a total of 358.3 hours sunshine for the 31 days of the month.

Turning to the July-August period for 1928 we find that conditions were what might be termed unfavorable for commercial honey production. The total rainfall for that period was 13.59 inches. (More than 4 times as much rainfall or precipitation as occurred during the 1927 two-month period.) Of this, 7.17 inches of rain fell during July

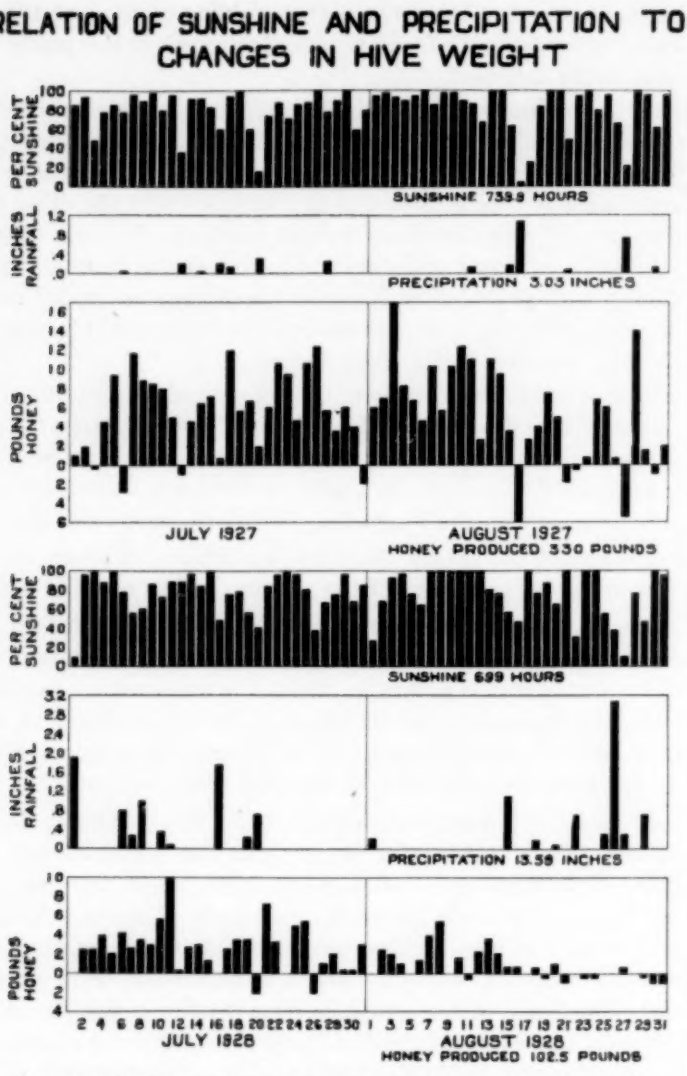

FIG. 28.—Relation of sunshine and precipitation to changes in hive weight.

and the balance of 6.42 inches fell during August. The net gain of the hive of bees on scales for this 1928 two month period was 102½ pounds; of which, 80 pounds net gain was for July and the balance of 22½ pounds was for August. A review of sunshine data for July of that period show

76% of possible sunshine or a total of 364.6 hours of sunshine for the month. August showed 76% of possible sunshine or a total of 334.4 hours of sunshine for the month.

In this connection it is of interest to mention the average spread between the maximum and minimum temperatures for the 1927 and 1928 periods respectively.

Maximum temperatures for these periods refer to day temperatures and minimum temperatures refer to night temperatures.

For July 1927 the average spread, between the maximum and minimum temperatures, was 20.5 degrees Fahrenheit; for August 1927 the average spread was 24.3 deg. Fah. As compared with a spread of 20.0 deg. Fah., for July 1928 and 22.4 deg. Fah., for August 1928. In other words the average spread between the maximum and minimum temperatures for the total July-August period of 1927 was 22.4 deg. Fah.; and, for the same period in 1928 was 21.2 deg. Fah.—A difference of 1.2 deg. Fah., in favor of the 1927 period.

So far, the weather factors, including rainfall, sunshine and temperatures have been mentioned. Briefly considering these, it would not appear that the slight reduction of hours of sunshine for the 1928 period as compared with the period of the previous year was a major factor in connection with the reduced yield of honey for 1928. For the July-August period of 1927 there was a total of 739.9 hours of sunshine, as compared with 699.0 hours of sunshine for the same period of 1928; this represents a difference of only 40.9 hours of sunshine in favor of the 1927 period.

To all appearances the low yield of 1928 was due largely to the excessively heavy rainfall occurring through the two-month period. It is probable that the rains acted in a three-fold capacity to prevent nectar gathering by the bees. While it was actually raining the bees were confined to their hives; and second, the heavy rains probably washed out or diluted the nectar in the flowers so that it could not be gathered after the rain had ceased. The third way in which an excessive amount of rain may probably affect nectar secretion, and indirectly gathering by the bees, may be by the effect of the rain on the soil. Of course, soils differ in their moisture holding capacities.

During the two month period of 1928, on several occasions, fields in the vicinity of the apiary became soaked with water and remained in that condition for several days following heavy rains. This condition was not apparent for the 1927 period.

THE EFFECTS OF MOVING BEES AT ORCHARD BLOOMING TIME[1]

By RAY HUTSON, B.Sc., *Assistant Entomologist, New Jersey Agricultural Experiment Station*

ABSTRACT

Data is presented which indicates that the movement of bees into and out of orchards is attended by an appreciable loss of young brood and queens. It is pointed out that these losses have an effect upon the later performance of the colony as measured by honey production.

The constantly growing practice of transporting bees into orchards at blooming time as insurance against insufficient pollination is hampered by lack of knowledge of the effects of moving under the conditions prevailing at that season. Migratory beekeepers have of course built up, in their thousands of years of experience, a great mass of empirical knowledge. This accumulation of wisdom has to do however with the preservation of the stock and is of limited application to the case in hand. The beekeeper in this latitude who undertakes to supply bees to orchardists is confronted as a routine matter, by a series of situations the migratory beekeeper studiously avoids. The primary fact confronting the beekeeper who contemplates moving bees into orchards at blooming time is the unreliable nature of the honey flow from fruit bloom. One needs little imagination to realize the working out of this condition. If there is insufficient honey in the hives, in case there is no flow, the bees starve or are so held back from brood rearing the colony cannot harvest a crop that season. The alternative course of providing plenty of stores for the rapid expansion of the brood-nest will result in swarming if a honey flow occurs. Movement of hives containing honey in cultivated orchards is uneconomical from several standpoints. This brief glimpse of the problem should reveal the existence of the number of variables which bear upon the movement of bees into and out of orchards for pollination.

The data presented were collected from observations of hives which were uniformly treated during each of the two seasons the work has been followed. Experience on a large scale using thousands of colonies over several years has shown that the moving method employed in these operations is best under the conditions when measured by actual loss of colonies by moving. Briefly this method consists in cleating on the bottom board of a one story hive, replacing the cover with a screened frame about 1½ inches deep, and stopping the entrance with a "V" shaped strip of painted screen wire. This arrangement provides

[1]Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

for ample ventilation except in cases of willful neglect and has the added advantage of permitting the best utilization of carrying space. In cool weather the inner cover is stapled, upside down, over the screen when preparing to load; if the day is hot the inner cover is not put on until the bees are unloaded at their destination. Metal covers were not used in the orchards.

The method followed in ascertaining just what happens to overwintered bees when subjected to the conditions imposed by moving into and out of orchards was that of examining lots of bees before moving to the orchard, in the orchard, and on the return to the summer location. The work was classified by calling any distance up to 30 miles a short haul and anything over that a long haul. The period the hives were closed had some bearing but it is hard to separate it from the length of haul, as it is usually unnecessary to close the hives for as much as 24 hours when moving less than 30 miles, while on the longer hauls the period of confinement may extend to 72 hours before the hives are placed in the orchard and the bees released. Identical methods were followed in the two years 1927 and 1928 in which observations have been made. The average population of the hives used in 1927 was 2.1 pounds; for 1928 2.8 pounds.

Fifteen colonies of bees were examined on April 26, 1927. They were moved 30 miles and distributed in an orchard on the afternoon and night of May 1. On May 3 these bees were examined in the orchard. On May 11 they were examined again after being moved from the orchard to the original location. The result of these examinations is shown in Table 1.

TABLE 1. EFFECT OF SHORT HAULS ON BEES, 1927

Hive Number	Brood 4/26/27	Brood 5/3/27	Brood 5/11/27	Remarks
1	2	2	3	
2	3	3	3	
3	3	2½	3	Few dead larvae
4	2	2	2	2 broken topbars
5	1	1	1	
6	3	4	5	
7	4	4	5	
8	2	2	3	
9	3	3	3	Queen gone
10	2	2	2	
11	3	3	3	
12	2	2	2	
13	4	4	4	
14	2	2	3	
15	3	3	3	

Twelve colonies of bees were examined April 16, 1928. They were moved a distance of 19 miles to orchards April 25 and examined May 1. After removal May 12 to the summer location 28 miles away they were again examined May 14. The findings appear in Table 2.

TABLE 2. EFFECT OF SHORT HAULS ON BEES, 1928

Hive Number	Frames of Brood			Remarks
	Brood 4/16/28	Brood 5/1/28	Brood 5/14/28	
1	4	6	7	
2	5	6	6	
3	5	6	7	Colony dead from smothering 5/14/28
4	5	6	7	Few larvae dead 5/14/28
5	6	7	7	
6	5	7	7	
7	5	6	7	Superseding 5/14/28
8	5	6	7	
9	5	6	6	
10	4	4	6	
11	3	5	6	
12	5	3	7	

The bees under observation during long hauls were overwintered in single walled hives. In 1927 the bees were examined on April 23, moved April 29, 80 miles, and distributed in orchards. These same colonies were examined on May 2 and again on May 12 after having moved to the old location. The 1928 observations were conducted on bees from the same location handled in the same way. The dates for the 1928 examinations were April 30, May 5 and May 20; the examinations after moving being made as in 1927, 3 to 5 days after the bees were moved. The results of the examinations are embodied in tables 3 and 4; table 3 for 1927; table 4 for 1928.

In 1927 package bees established in orchards showed no effect from moving short or long distances. Thirteen of fifteen packages moved 80 miles in 1928 lost their unsealed brood.

During both 1927 and 1928 checks were provided by observations on 5 hives left on the winter locations. The hives maintained as checks were comparable in amount of bees, brood, and honey to those moved to the orchard in the spring and received the same summer care as the hives returned from the orchards. Bees moved short distances produced practically the same amount of honey as bees left on same location during orchard blooming time in 1927, an exceptional honey year in New Jersey. The check colonies on short hauls produced slightly more than the moved colonies in 1928, a light honey year. During 1927

the check colonies on long hauls produced an average of 45 pounds more honey per colony of the average for the moved bees in the yard. In 1928 the checks on long hauls produced an average of 25 pounds more honey per colony than the moved bees in the yard.

TABLE 3. EFFECT OF LONG HAULS ON BEES

Hive Number	Frames of Brood 4/23	5/2	5/12	Remarks
1	5	5	6	Few dead larvae on May 2.
2	3	3	3	Very few larvae less than 4 days old on May 2. Queen established new brood nest on second move.
3	3	3	3	Few dead larvae May 2. Queen gone May 12.
4	2	2	2	Supersedure cells May 12.
5	4	5	5	O. K.
6	3	3	3	One-eighth brood dead, all stages.
7	1	2	3	O. K.
8	3	3	2	Queenless after 5/2.
9	1	1	1	No unsealed brood. May 2.
10	3	3	3	Marked break in brood rearing May 2. May 12 queen mauled.
11	2	2	2	Queen started new brood nest at one side of hive.
12	4	4	5	2 broken topbars on frames containing honey.
13	2	2	2	May 2, queen started new brood nest at side of hive. 2 topbars on frames containing honey broken.
14	2	3	4	O. K.
15	4	5	5	O. K.
16	3	3	4	May 2, 25 per cent of brood less than 6 days old dead.
17	2	2	3	O. K.
18	3	3	4	O. K.
19	4	4	4	May 2, queen established new brood nest at one side of hive.
20	5	6	6	Emergency cells present.
21	5	6	7	O. K.
22	4	4	4	25 per cent 3-day brood dead May 12.
23	5	6	6	5 per cent all stages brood dead and being disposed of by bees.
24	3	3	4	40 per cent of larvae less than 3 days old abandoned.
25	3	3	4	10 per cent of all brood dead.
26	4	4	5	May 12, queen establishing a new brood nest.
27	2	2	2	May 12, brood nest deserted and started anew.
28	3	4	5	Queen dead May 12.
29	4	5	6	Few 3-day larvae dead.
30	5	5	6	Queen dead May 12.

Examination of the data adduced in this paper shows that the beekeeper who undertakes to supply bees for pollination in orchards must face the possibility of losses under certain conditions. The loss does not appear as a total loss of colonies, although he must constantly

TABLE 4. EFFECT OF LONG HAULS ON OVERWINTERED BEES, 1928

Hive Number	Frames of Brood 4/30/28	5/5/28	5/21/28	Remarks
1	5	5	7	5/5 No unsealed brood.
2	4	4	6	5/21 No unsealed brood.
3	3	4	5	5/5 Queen moved.
4	5	6	6	5/5 No unsealed brood.
5	3	4	5	O. K.
6	5	5	5	5/21 Queen superseded.
7	7	8	9	5/21 No unsealed brood.
8	4	4	5	5/5 Few dead larvae.
9	2	3	4	O. K.
10	3	4	5	O. K.
11	4	4	5	O. K.
12	6	7	8	5/5 No unsealed brood.
13	3	3	4	5/21 No unsealed brood.
14	2	3	4	
15	2	3	4	5/5 No unsealed brood.
16	4	5	6	5/21 No unsealed brood.
17	2	3	5	
18	5	6	8	5/21 No unsealed brood.

guard against that exigency, a fact apparent from Table 2 on a short haul. The losses appear rather as a sapping of potential strength of all the colonies moved distances above 30 miles. The damage to unsealed brood in the hives is a loss the extent of which can only be estimated. In Table 4, 9 of 18 hives suffered this loss. The loss of brood from re-establishment of the broodnest is sometimes complete. This occurred in 6 out of 75 cases in the two years. The loss of queens amounts to 4 dead and 2 definitely superseded. Why most of the queenlessness occurred in 1927 is unexplained by the facts at hand.

The loss in building up power of the colonies resulting from damage to the brood can only be conjectured. The loss from dead queens might be figured on a replacement basis with the consequent ignoring of the value of the queenless period. The damage to equipment is negligible. The loss of one colony of bees in moving 75 is not serious. The only definite thing by which we can measure the sum of these losses, and there are of course faults in using it, is the honey crop. In 1927 and 1928 there was no great difference in the crops from bees moved up to 30 miles and bees left in the apiary at blooming time. The results in the case of the bees moved more than 30 miles shows a definite loss of approximately one-half the normal crop for the locations under consideration. It should be pointed out also that this loss would be on the early flow.

DEFINITION OF A COMMERCIAL BEEKEEPING REGION

By E. F. PHILLIPS, *New York State College of Agriculture, Cornell University, Ithaca, N. Y.*

ABSTRACT

An attempt to analyse the development of commercial honey production in the United States and to account for some of the changes in the location of commercial beekeeping which have occurred. Certain changes in plans for the advancement of beekeeping are suggested.

Before commercial honey production may be profitable, the first requirement is that the location shall be a good one. It is usually assumed that almost any skilled beekeeper will recognize a location suitable for commercial production, yet there has apparently been no attempt to set forth the present requirements for such a location. During the years since honeybees were introduced into this country, there have been repeated siftings and shiftings, and today the commercial production of honey is restricted to a small part of the total area where bees may be kept with profit. The present condition has been reached by experience at tremendous cost and by myriads of examples of trial and error, for it would appear that attempts to engage in commercial beekeeping have been made almost everywhere that bees may be kept. An analysis of this situation will probably not be immediately profitable, yet it is by no means impossible that the final solution of some of the serious problems of beekeeping, such as the marketing problem, may rest on some such considerations.

The first stage of analysis is doubtless to eliminate some erroneous impressions, for interesting stories of commercial progress have doubtless created errors of opinion which are difficult to eradicate. The amount of nectar in an area is not the determining factor, for many parts of the country where there is no commercial beekeeping produce average crops and total production as good as or better than these averages in commercial areas. If one lists the first few states in their order of total honey production, the following are included: California, Texas, Iowa, Illinois, New York, Kentucky, Wisconsin, Missouri, North Carolina. So far in the list one does not encounter Michigan, the fourteenth state, Colorado, nineteenth, or Washington, the twentieth, while Iowa, Illinois, Kentucky, Missouri and North Carolina are not classified as commercial beekeeping states or as important in producing honey for the general markets. One naturally asks what becomes of the honey produced in such vast amounts by these states. If the states are listed in the order of their average per colony crops, it is again found that the most important commercial states do not head the list.

The color and flavor of the honey are not determining factors, although it is as a rule true that locations producing light and mild honeys are better suited for commercial development than are those of which the honeys are dark and strong. The buckwheat region of the East is an outstanding example to the contrary. On the general markets there is a preference for mild and light honeys, but such discriminations rarely exist on local markets. Many bottlers seem to think that this distinction between general and local markets does not exist, and many beekeepers have been led so to believe. This phase of the problem might be developed at length, and while the statements here made cannot perhaps be accepted at first glance, further study will surely show their accuracy.

The number of colonies that may be kept in one apiary is not the determining factor. In the non-commercial areas there are many locations where one hundred colonies or more are kept profitably on one site. In such cases the average crops per apiary may be as good as or better than those obtained by the average beekeeper in commercial areas.

The commercial regions do not produce the bulk of the nation's honey crop; in fact, they produce a minor part of it. Beekeepers and shippers who handle honey in car lots are prone to believe that the production of beekeepers owning only a small number of colonies is of little importance on the markets, but even a casual glance at the market should show the error of such an opinion. The commercial areas produce considerably less than one-fourth of the total honey crop of the country. If all the honey produced is sold, as is unquestionably true, then this small amount of the total crop is not the dominating factor in determining prices. The wholesale markets are strongly influenced by the production of the commercial areas, but just as soon as honey from any region reaches a local market, it comes in competition with all the honey of that market, so that the production of small holders is the largest factor in setting prices on the grocer's shelves throughout the country.

The total area of the country may be classified into lands suitable for beekeeping and those not so suited. The suitable areas may be grouped into regions of major and minor importance, this distinction depending not so much on size as on total production and influence in devising distinctive beekeeping practices. The major regions in order of importance are: white clover, alfalfa, sage, the semi-arid areas of Texas and adjacent states and the humid regions of the southeast. Interspersed among the major regions are many minor regions, some of

which, like buckwheat, raspberry and willowherb are important on the markets. The buckwheat region is almost the only minor region where any distinctive beekeeping practices are found.

There are certain important limitations to commercial development. Of the 1903 million acres in the continental United States, 478 million acres of improved land may be subdivided into 319 million acres in crops, 84 million in pasture and 75 million fallow. These were the figures for 1910 and the improved areas have perhaps decreased slightly since that year. Of the remaining great part, 600 million acres are in forests and woodlands, 745 million acres in range and grasslands, 40 million in desert and 40 million in cities, towns, roads and other man-made changes. The total land capable of improvement for agriculture is placed at 850 million acres, the addition from present conditions being possible through added irrigation (1.6%), drainage (3.2%) and dry farming and the transformation of woodlands and range into farm lands (10.5%). As a rule these marginal lands will be less profitable for agriculture than the land now under cultivation. From a beekeeping standpoint we may largely discount forests, mountains and desert areas and the cities, towns and roads, which means that over half the total area is virtually useless for supporting bees, certainly useless for commercial beekeeping.

Beekeepers are inclined to consider the irrigated areas as highly important in honey production. About 30 million acres are under irrigation, approximately 1.5% of the total area, and this can scarcely be more than doubled. There is strong sentiment against the undertaking of more government irrigation projects until those now under cultivation begin to pay for themselves, so that the total possible increase will not be realized for many years. The present irrigated areas constitute a minute portion of the beekeeping area, as compared with the honey producing areas of the East, both as to total crop and in influence on the markets.

The commercial areas for the entire country are, however, exceedingly restricted. Perhaps 10% of New York and 5% of Ohio might be so classified. Most of the irrigated areas and a considerable area in southern California must be included. The commercial areas will be increased by more irrigation and drainage, but all these together would not by any means double the commercial areas. Other factors will also doubtless be far more important than irrigation and drainage in determining the future commercial development of the country. It is safe to say that the present commercial areas constitute less than 10% of the entire

area in which bees may be kept with profit, which is less than 5% of the entire country.

There are social limitations to the commercial development of beekeeping which must not be overlooked. In earlier days when the cost of living was less in pounds of honey per year and when many things that are now considered necessities were either luxuries or did not exist, commercial beekeeping was far more widely practiced throughout the country than it is today. Many of the leading commercial beekeepers of thirty years ago were located in areas where there is now no commercial beekeeping. There were, for example, commercial beekeepers in almost every county in New York State. This marked change is in most cases not at all due to any change in the nectar plants, although in certain eastern states the lumbering of basswood played an important part. The transformation of certain areas into non-commercial regions is due more largely, however, to changes in social conditions over which beekeepers and the beekeeping industry have no control.

The first impression which one gets from such a situation is that this change has been brought about entirely by a lowering or by a relative lowering of honey prices, but this is true only in part. The great need in beekeeping, as stated by most beekeepers, is for an advance in honey prices, and it is certainly true that honey prices must exceed production costs by a better margin than at present if the business is to continue. There are, however, certain other things which are as necessary to consider as are honey prices. Any relative lowering of prices of honey or any other agricultural commodity serves to drive out of commercial competition the areas which are marginal in character, and this seems to be exactly what has happened in beekeeping. Conversely, a raising of prices brings these marginal areas back into competition. This was shown clearly during the period of the War, when many regions that were immediately before that time non-commercial, at once became commercial areas. This shifting has been going on for years and still continues, so that one must reckon with it in all plans for the development of beekeeping. Any advance in wholesale prices of honey without a compensation from other factors would at once bring into competition many marginal areas and it is easily believable that an advance of twenty per cent in honey prices would double the amount of honey on wholesale markets, thus promptly again reducing wholesale prices to the present level or lower.

It is often said that the War brought about a great increase in the number of commercial beekeepers and that our present marketing

trouble is due to the fact that many of these men have remained in the business after prices have dropped, thus bringing about the present decline in wholesale prices. This is doubtless true to some extent, but it is also equally true that there are fewer persons engaged in commercial honey production now than there were thirty years or more ago, when we take into consideration the changes in the definition of a commercial beekeeper. In those days a man was sometimes a commercial beekeeper who operated only one apiary, whereas at present a commercial beekeeper must operate several outapiaries. It is doubtless true that there are more extensive beekeepers at present than before the War although this situation is changing also.

A stage has now been reached in the formulation of a definition when some of the more strictly beekeeping factors should be considered. The timing of the honey-flow is perhaps of first importance. In all commercial areas at present, with the slight exception of the buckwheat region, the main honey-flow on which the beekeeper depends comes just at the natural peak of brood-rearing. This reduces apiary management to the lowest possible terms and means that commercial honey production is chiefly practiced where the proper management of the colonies demands a minimum of labor and especially of study in the devising and use of specific regional methods.

European foulbrood may be considered as a factor, although great care must be exercised here. Many of the present non-commercial areas are places where this disease exists and where it causes or has caused much damage, but this too is largely a matter of the timing of the honey-flow. This disease was one of several things that despoiled some formerly good commercial areas, but, like the War, it seems only to have hastened things that were otherwise inevitable.

For present day commercial beekeeping, outapiaries are a necessity, yet here again one must exercise care in forming a judgment. It has generally been thought that a number of outapiaries near together is an essential, yet with good roads and modern transportation, this is no longer true. Many beekeepers now operate outapiaries a hundred miles or more from the home apiary. The time and labor per colony is a primary factor, and this is now attracting attention in cost studies, but care must be exercised that we are not misled by these. The time in reaching an apiary is of course part of the total cost, and if the distance is too great, the cost is excessive.

These phases of the problem may be left now to suggest certain historical facts in the development of beekeeping in this country.

Some of these observations will doubtless be denied or questioned by many beekeepers, but it is important to observe that modern beekeeping methods are products of the white clover-basswood region, a region formerly more important than at present because of the abundance of basswood, which furnished nectar after white clover. If one looks over the literature, he finds that the important books and journals from other beekeeping regions are exceedingly rare. Few inventions to facilitate the work of the beekeeper have come from other regions. These facts are amazing and almost unbelievable, yet these facts have a vital bearing on the present status of beekeeping in the country. It is useless to review the names of well-known men who have made beekeeping what it now is, but their geographical locations and the consequent methods advocated are of vast importance. Since the literature, the appliances and the practices have come from one region, it is obvious that there is something unbalanced in our beekeeping. No method for the control of a brood disease, no method of swarm control, no advance in wintering methods and virtually no help in the solution of other important problems have come to us from other regions. This might be discussed at great length, but the purpose of this suggestion is to indicate the importance of some new methods of attack on some of our problems.

It is unfortunate that an attempt should be made to formulate a definition of conditions governing the suitability of a region for commercial beekeeping without opportunity to go into greater detail on these and other important points, but a suggestion will be made of such a definition, in the hope that others will think along these lines and will likewise attempt to perfect this definition. The usefulness of the definition lies almost solely for the present in its suggestiveness of different methods of attack on some of our problems.

A region now suitable for the development of commercial beekeeping is one in which the main, dependable honey-flow occurs at such a time of the season that present methods of colony management, devised years ago in the white clover-basswood region and capable of application with a minimum amount of labor and study, serve the average beekeeper moderately well in bringing his colonies in outapiaries to such strength before the beginning of the honey-flow that a crop of honey may be obtained in average years of such quality and quantity that its sale will provide an income adequate to maintain the beekeeper and his family on a social scale equal to at least the average of his community and which will also compensate for extra transportation costs in carrying the honey to the ultimate consumer.

If this definition even approximates the truth, there are presented to those interested in the promotion of beekeeping a myriad of problems. It has at any rate seemed worth while to speculate about this for a few minutes, and it is hoped that others may think and observe on these lines. Certainly the promotion of beekeeping is a complex problem and we have rarely considered its complexity enough.

Some apology is due for the presentation of a speculative discussion such as this, but it pays occasionally to divorce ourselves from details and to take a broader view of the field in which we labor. A discussion such as this must be based on the experience and observations of thousands of beekeepers and, with no former attempts to guide one, there is always the chance that false conclusions will be reached. The author believes that in general the situation is as here stated.

Our task in the promotion of beekeeping in the United States seems to rest largely on further study of the influences which have determined present commercial beekeeping. The non-commercial areas, producing by far the major portion of the nation's honey crop and containing by far the largest number of beekeepers, have formed too small a part in planning development in production and marketing. There is excellent reason, which cannot here be developed, for believing that the present troubles in marketing are due to a belief in the importance of the commercial regions and to a gross neglect of the sale of the honey of non-commercial regions. There is reason to believe that until more attention is paid to the major part of the beekeeping area of the country, any important improvement in the economic side of beekeeping will be wholly impossible. There seems to have been a feeling almost akin to fear of attacking this problem, perhaps through fear of criticism from commercial beekeepers who are in serious straits at present, but it is for their good more than for the good of any other group of beekeepers that the vital necessity of making conditions better in the areas now considered non-commercial must be recognized. This does not at all mean that an attempt should be made to develop non-commercial areas into commercial regions, for that would be the height of folly, but it does mean that until help is given the beekeepers now classed as amateurs, there is small hope for the more extensive producers.

With white clover-basswood methods dominating the beekeeping of the entire country, it is obvious that the outstanding need of beekeeping is the formulation of proper practices so that the abundant nectar of dissimilar regions may become available. When special regional laboratories are established, their greatest function is to devise

such practices and not to work out further details of special methods for small groups of specialist beekeepers, such as queen-breeders. So long as such vast amounts of nectar are lost because of the use of unsuitable practices, there is scant hope of raising beekeeping to the high level of efficiency and proficiency for which we hope.

Neither is there hope for a betterment of honey marketing so long as the honey of non-commercial areas is so largely neglected in our plans. It is no longer desirable to attempt to use the same methods of teaching in regions of the two types, as has unfortunately been done to a large extent in the extension work. It will require a careful demarcation of the regions, based on better study than has yet been given this problem, before we will be able to attack these problems intelligently.

THE INFLUENCE OF HUMIDITY UPON SUGAR CONCENTRATION IN THE NECTAR OF VARIOUS PLANTS

By O. W. PARK, *Iowa Experiment Station, Ames, Iowa*

ABSTRACT

Sugar concentration in nectar was found to vary inversely with relative humidity. Correlation between these two factors was found to be much closer in some types of flowers than in others. The Abbé refractometer was found highly satisfactory for determining sugar concentration in nectar.

Nectar is the raw material from which honey is made and, as such, the beekeeper is interested in the various factors which influence its production. Bonnier (1) found that the quantity of nectar secreted varied directly with relative humidity. Ostashenko-Koodryavzeva (5) of Russia, and others have found that nectar usually is secreted most abundantly during periods of high humidity, but, in most cases, investigators have failed to determine whether, or to what extent, the sugar concentration was altered under such conditions.

An increase in nectar secretion is generally looked upon as favorable for honey production; but, since nectar may contain much or little sugar, increased secretion is not necessarily advantageous for honey production, unless there is an increase in the amount of sugar made available to the honeybee. Kenoyer (4), following the lead of Haupt (3), showed, under experimental conditions, that, altho flowers of buckwheat, *Fagopyrum esculentum*, and of touch-me-not, *Impatiens sultani*, kept in air having 100 per cent humidity, secreted larger amounts of nectar than did those exposed to the rather dry greenhouse air, the total

amount of sugar produced was not increased thereby. It is quite possible therefore, that increased secretion may be a disadvantage at times, so far as the production of honey is concerned.

Historical

In the past there have been two great difficulties in the way of securing data on nectar and the factors influencing its production. First, the difficulty of obtaining sufficient quantities for investigation, and second, the lack of methods of analysis adapted to such small quantities as could be secured. Analyses made prior to the last few years, with few exceptions, have been accomplished by extracting the sugar from a given quantity of flowers by means of water or alcohol. Chemical determinations then showed the total amount of sugar, from which the average amount per flower was easily computed. This procedure probably extracted more or less sugar from the tissues of the plant in addition to that of the nectar. And, since this method was not well adapted for determining the sugar concentration, very few such determinations have been made heretofore. It is largely due to these facts that our knowledge concerning the concentration of sugar in the nectar of various plants and under different conditions, has been so very meagre.

The classic reference to nectar analyses is that (6) which gives the results obtained about fifty years ago by the Swiss chemist, Planta, who determined the per cent of sugar in fresh nectar from four different sources, as follows:

Source	*Per cent Sugar*
Protea mellifera	17.1
Hoya carnosa	40.6
Tecoma radicans, trumpet creeper	15.3
Fritillaria imperalis, imperial crown	6.6

In 1916, Kenoyer (4) reported that the nectar of the touch-me-not, *Impatiens sultani*, in an atmosphere saturated with moisture, contained 23.4 per cent sugar; while in the drier greenhouse air, the same species yielded nectar containing 45.3 per cent sugar.

Caillas (2), in 1926, determined the sugar content of nectar from orange blossoms, *Citrus aurantium*, as 26 per cent.

According to Vansell (7), the recent work of Miss Beutler of Germany reports comparative data for three plant species from samples obtained under normal conditions and during rain. The following results are given:

	Per cent Sugar	
	Normal	*During rain*
Plum	32.5	15.6
Milkweed, *Asclepias sp.*	27.9	7.9
Horse chestnut	75.2	49.1

Bentler's data, in themselves, would be of little value, because nectar gathered during or soon after a rain is almost sure to have been diluted by rain water. This is particularly true in the case of the open and more upright flowers such as plum and milkweed. It will be noticed that Bentler's results showed a much greater dilution in nectar from these sources than from horse chestnut, in which the nectar is more protected from the rain.

Thus it appears that data so far published, have been sufficient only to suggest the probability of an inverse relationship between humidity and sugar concentration in nectar.

Methods

Studies on the sugar concentration of nectar from various plants were begun by the writer in June 1926. Since that time, hundreds of samples from numerous species of plants have been collected and analyzed. The nectar was collected by means of specially designed glass pipettes, and the samples were analyzed with the least possible delay.

Sugar determinations were made by various chemical methods, of which two were quite satisfactory except that they required laboratory facilities and consumed considerable time. During the season of 1927, there occurred to the writer the idea that the concentration of sugar in nectar might be determined by means of an Abbé refractometer. Early in 1928, a series of tests showed this instrument to give results which checked well with those obtained by chemical methods. In fact there are good reasons to believe that the refractometer readings are more reliable than those secured by chemical means. Details in this connection will be published elsewhere as available space does not justify further discussion here. The refractometer method embodies simplicity, accuracy and speed. Laboratory facilities are not needed. The instrument is easily transported and can be used right in the field.

Records of temperature and humidity were kept at all times by means of self-recording instruments housed in the usual type of weather shelter.

Results

The work of the first two seasons showed a considerable variation in the sugar content of nectar from a given source obtained at different hours of the day. Plans were made to secure more extensive data along this line during 1928. Discovery of the refractometer method early that season made it possible to make determinations so easily and so rapidly, that on various occasions, determinations were made at frequent intervals from morning until night, or during that part of the day during which samples could be obtained. Only a brief summary of some of the outstanding points will be given. Data secured from basswood, *Tilia americana;* milkweed, *Asclepias syriaca* and trumpet creeper, *Tecoma radicans*, will serve to illustrate most of the points to be discussed here.

Figs. 29, 30 and 31 are graphic representations of the variations in the percentage of sugar found in nectar at different hours of the day, together with temperature and humidity conditions existing at the time the various samples were gathered. Most of the points plotted in the sugar curves for basswood and milkweed represent the mean of several samples, sometimes as many as ten. Statistical studies of the data at hand are being made and will be published in the near future.

Basswood. As a rule, the nectar from 25 florets was used for each sample from basswood. This usually required from 2 to 4 flower clusters which generally were taken from the lower branches, within one's reach from the ground. There are five trees in the row which runs north and south, bordering Welch avenue, one block south of the Campus of Iowa State College, on the brow of a hill. The trees are nearly a foot in diameter at the base and about 25 feet high. It was observed repeatedly that, altho the nectar was far more abundant in early morning than later in the day, the bees did not begin work on it to any extent until after 8 o'clock.

Referring to Fig. 29, it will be noticed that data are given for parts of two days, July 5 and 6, 1928. In order to obtain a general idea of the trend, and extent of variation in basswood nectar during the course of a fairly typical day in early July at Ames, Iowa, we may mentally superimpose Fig. 29, B upon Fig. 29, A so that it occupies its proper position with respect to the time of day. Allowing somewhat for the fact that weather conditions for the two days were not identical, the curves for temperature, humidity and sugar will each be practically continuous from 6:30 a. m. to 8:30 p. m.

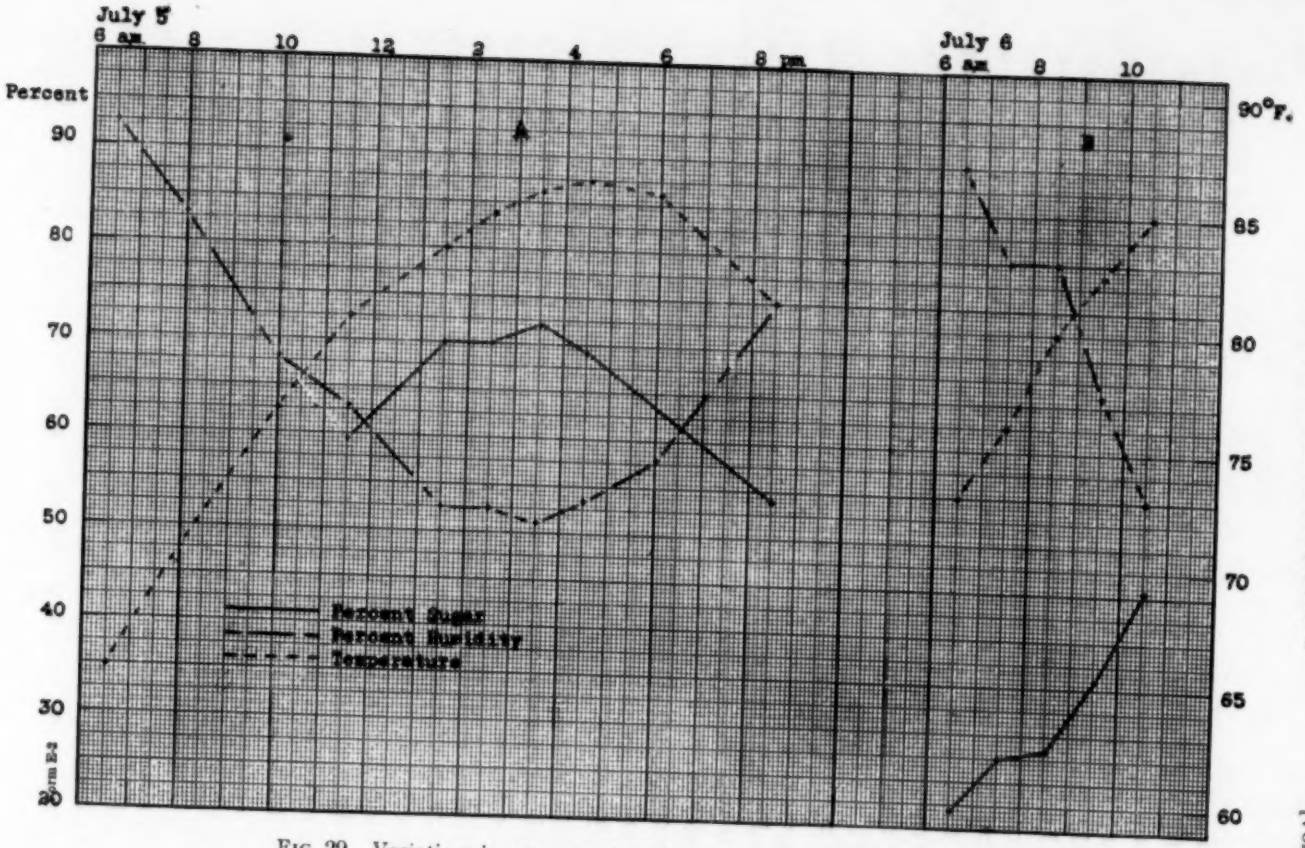

FIG. 29. Variations in concentration of sugar in nectar from basswood.

These curves show that, while in general, sugar concentration varied in the same direction as temperature, the relationship between these two factors was not very close. This is shown by the fact that between 7:30 and 8:30 a. m. and again between 1:30 and 2:30 p. m. the sugar curve remained practically on a level; whereas, in both cases, the temperature curve continued its normal upward progress. Furthermore, the maximum sugar concentration was reached a full hour before the

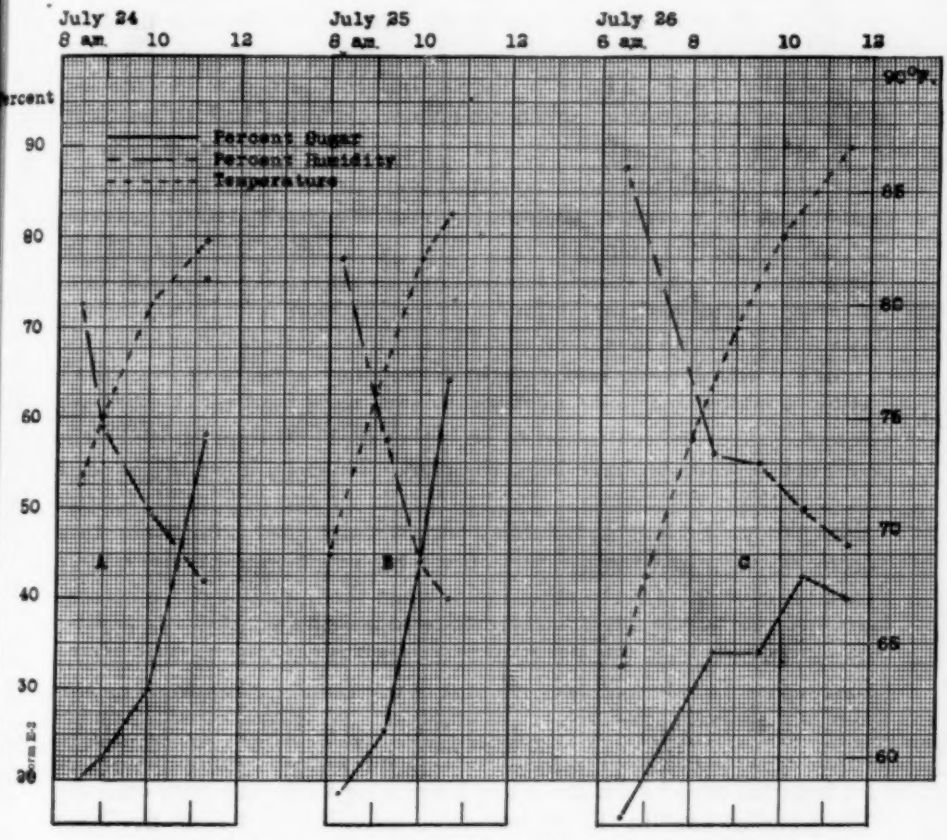

FIG. 30. Variations in concentration of sugar in nectar from milkweed.

maximum temperature, and the decline of the sugar curve was more abrupt than that of the temperature.

In brief, the sugar curve did not closely resemble the temperature curve, but was almost exactly the reverse of the relative humidity curve, as shown in. Fig 29.

MILKWEED. The common milkweed has been grown for experimental purposes on a plot of ground approximately 25 by 75 feet, located near the campus of Iowa State College for several years. The ground is about level but is well drained. The soil is fertile, having been used previously for truck crops for some years. During the spring and summer of 1928, rains were sufficiently frequent to produce vigorous growth and the rows of milkweed plants stood about 6 feet high. Nectar usually was very abundant in early morning, but by noon little if any could be obtained, which explains the absence of afternoon data for this plant. During the early part of the morning, an adequate sample was usually obtained from 25 florets, but as the nectar became less abundant, toward noon, greater numbers of florets had to be used.

Data obtained on July 24, 25 and 26 appear in Fig. 30. Much as in the case of basswood, the sugar concentration curves for milkweed nectar are almost the reverse of the relative humidity curves, altho the correlation may not be quite as close. And again the sugar concentration shows a much closer correlation with relative humidity than with temperature. In general, minimum concentrations were found when humidity was highest and maximum sugar concentrations were found when the humidity was lowest, but a slight discrepancy appears in Fig. 30, C. Altho humidity continued to decrease until noon, and we should have expected sugar concentration to be higher at 11:30 than at 10:30, the contrary appears to have been the case. There is, however, at least an even chance that some unusual circumstance was responsible for this discrepancy. So long as humidity curves maintained a fairly constant decrease, sugar and temperature curves both took upward, but seldom parallel, courses. On the other hand, when the humidity curve became irregular, as in Fig. 30, C, while the temperature continued a regular course, the sugar curve for milkweed nectar was found to be very nearly the reverse of the humidity curve, just as was found for basswood nectar.

TRUMPET CREEPER. Trumpet creeper yields nectar in large quantities as compared to most plants. This was one of the four sources of fresh nectar used by Planta (6) in his pioneer work on nectar analysis. The samples used in the present work were obtained from five large vines, growing in three different locations but in similar situations.

Each of the three sugar records indicated for July 12 (Fig. 31, A.), represents the nectar obtained from all the blossoms found at one of the three locations just mentioned. The differences shown in the sugar content of the three samples are just about as expected under the corresponding changes in humidity.

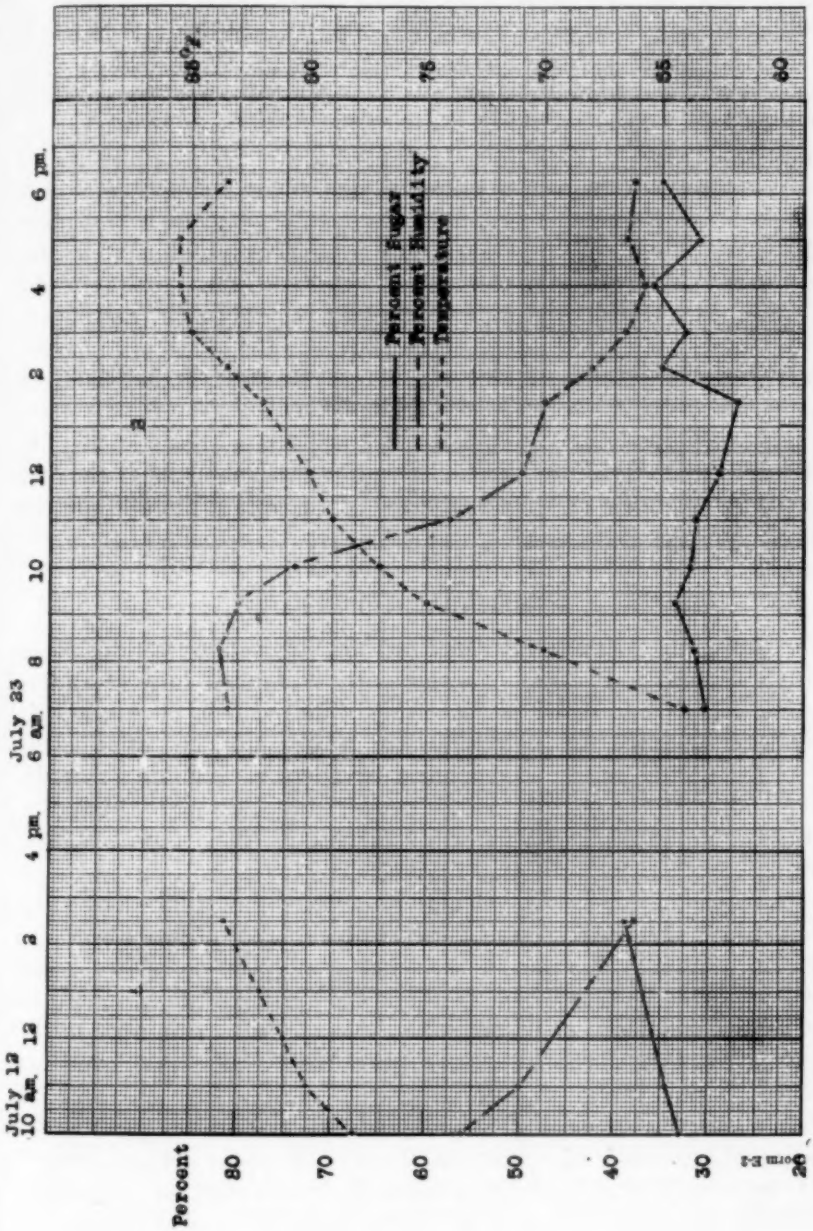

FIG. 31. Variations in concentration of sugar in nectar from trumpet creeper.

Each point plotted in the sugar curve shown in Fig. 31, B. was determined from the nectar content of from four to six individual blossoms, all from one vine. A general trend which is somewhat correlated with the reverse of the humidity curve, can be discovered, but discrepancies are numerous. Some of the factors which are believed to have contributed to these discrepancies are as follows. The samples represented too small a number of blossoms, due to the fact that the principal period of bloom was past so only a few blossoms were available; some were too old and some too young to give representative results; some were shaded, others in the sun. It is believed that, upon securing a duplicate set of data from trumpet creeper, based upon a truly representative number of blossoms, the sugar curve would be found to have a much closer correlation to the humidity curve than is indicated in Fig. 31, B.

It is quite clearly indicated, not only by the data shown in. Fig 31, but also by many samples obtained at various other times, that trumpet creeper nectar varies much less in sugar concentration than do nectars from many other sources.

General Discussion

Studies similar to those just described were made upon various other sources of nectar. In every case, humidity was found to have an important influence upon the concentration of the sugar in the nectar. It is evident, therefore, that determinations of the sugar content of nectar are of little value unless accompanied by adequate humidity records.

A number of other factors besides temperature and relative humidity influence the concentration of sugar in nectar. It is probable also, that different plant species may react differently to any given factor or combination of factors. A given factor may exert more influence on one plant species than on another. It is possible then, that in some plants the concentration of sugar in their nectar may be correlated more closely with some other factor than it is with relative humidity; but, so far, no such case has been found.

As an example of the fact that a given factor may exert more influence on one species than on another, it may be pointed out that relative humidity appears to have a greater effect on the sugar concentration of basswood and milkweed than on trumpet creeper nectar. It is believed that differences in types of flowers may be responsible for these variations. Flowers in which nectar is usually secreted in comparatively small quantities, and especially those in which the nectar

is much exposed, show wide fluctuations in sugar concentration in their nectars, which vary inversely with relative humidity. On the contrary, flowers in which nectar is secreted in comparatively large quantities, and especially those in which the nectar is well protected, show considerably smaller variations in sugar concentration with changes in humidity. To the former class belong basswood, raspberry, milkweed, the various clovers, sweet clovers and many others of our most important honey plants. To the latter class, belong trumpet creeper, day lily, gladiolus and canna, which are comparatively unimportant to the beekeeper.

It is to be observed that in early morning, when humidity is very high and when most flowers are considered to be secreting nectar most actively, the sugar concentrations for all three sources discussed here were quite similar, ranging in the neighborhood of 20 to 30 per cent. As relative humidity decreases, evaporation of water from nectar increases. Thus the exposed nectars of basswood and milkweed become concentrated much more rapidly than does that of trumpet creeper, which is much less exposed. Nectar, being hygroscopic, may be expected to absorb moisture from the air with an increase in relative humidity; and the more concentrated the nectar, the faster will it absorb moisture. Other things being equal, the larger the amount of nectar, the more slowly will variations in humidity affect its concentration.

If the increase in quantity of nectar under humid conditions is due entirely to an increase in water content, as shown by Kenoyer (4) and others, it must result in reduced honey production in many cases for two reasons. The nectar is less attractive to the bees because of its greater dilution, and a larger amount of it must be handled for each pound of honey produced. This not only involves additional labor on the part of the bees, but also tends to reduce the incentive for gathering it.

On the other hand, there probably are instances in which the honey crop is augmented by an increased water content in nectar. In the case of flowers, such as red clover, *Trifolium pratense*, which have corolla tubes so deep that the honeybee's tongue, under normal conditions, cannot reach the nectar, an increase in its water content may enable the bees to secure a portion of the sugar by filling the corolla tube with nectar to such a depth that honeybees can reach some of it. In such cases, the increased water content may make all the difference between honey production and no honey production.

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SUCCESS IN THE ARTIFICIAL INSEMINATION OF QUEEN BEES AT THE BEE CULTURE LABORATORY

By W. J. NOLAN, *Bee Culture Laboratory, Bureau of Entomology, United States Department of Agriculture*

ABSTRACT

Watson's method for the artificial insemination of queenbees has been used successfully at the Bee Culture Laboratory in 1927 and 1928.

It is now over two years since Doctor Watson announced to a somewhat skeptical beekeeping world his success in artificially inseminating queenbees by a method developed by himself. Although the news of his discovery rapidly travelled to the four corners of the globe, and although more or less lengthy articles in regard to it soon appeared in practically every beekeeping journal of the world, no confirmatory statement by anyone who has successfully used Watson's method has appeared in print as yet. In this respect the Quinn-Laidlaw method has enjoyed a slight advantage, for Doctor Prell, of Germany, announced somewhat briefly in the Leipziger Bienen Zeitung for November, 1927, his success in inseminating queenbees by a method which seems from the published account almost identical with the Quinn-Laidlaw method with the exception that he removed the drone's genital organs from the body of the drone before attempting to place them in proper position to accomplish insemination, whereas by the Quinn-Laidlaw method (Bee World, Oct. 1923) these organs are caused to extrude directly from the male into position in the queenbee before they are cut or torn loose.

That no one has published a confirmation of Watson's results can not be interpreted as indicating any lack of interest in his method on the part of other investigators. This is shown by the fact that since his demonstration before the meeting of the Apicultural Section of the American Association of Economic Entomologists, held in Philadelphia in 1926, the first public gathering of beekeepers before whom he demonstrated his method, Watson has supplied his pipettes to several institutions and investigators, including the Bee Culture Laboratory. In some instances investigators have attempted to make their own instruments.

In view of the wide interest in the artificial insemination of queenbees, and also because Doctor Alpatov, in the issue of Pchelovodnoe Delo for July, 1928, referred to results obtained by the writer at the Bee Culture Laboratory, it now seems fitting to state that the Watson method of artificially inseminating queenbees has been used with such success at the Bee Culture Laboratory during 1927 and 1928 as to justify all of Watson's claims. Furthermore, so far as is known, the first success in the use of his method by anyone other than Watson himself was achieved at the Bee Culture Laboratory. About nine months from the time Watson had convinced his examining committee at Cornell University of the workability of his method, worker bees, which had developed from eggs laid by a queenbee inseminated artificially through the use of the Watson method by the writer, were emerging in the apiary of the Bee Culture Laboratory.

Until now the success of only one other person in the use of the Watson method has been called to the writer's attention. In a private communication to the writer, dated October 22, 1928, A. S. Mikhailoff, of the Tula Experimental Station, in Russia, stated that during the summer he had attained complete success in two instances, and partial success in others. His achievement is the more noteworthy in that he himself, aided by a locksmith, made a pipette and a pipette holder for this purpose with only Watson's book as a guide. Doubtless other instances of the successful use of this method will soon be forthcoming.

Only those who have made an earnest effort to use this method can appreciate Watson's difficulties and the discouragements under which he must have labored in working it out. His success becomes all the more brilliant when we consider that relatively few of those with whom he came in contact encouraged him in his efforts. Even the acknowledgment of his success by beekeepers here and abroad did not put an end to the many discouragements which so far have attended the use of his

method. Thus, on July 18, 1927, he said in a letter to the writer: "Your letter of July 13 with the refreshing news of your success in the case of one queen came just at the time of considerable depression in my work when a fine appearing queen had been inseminated for the fourth time, and apparently with no success. Frankly, getting back into the swing of this grilling delicate experiment is not an easy task for me and I guess I needed the inspiration of your letter to set me at it anew." This is mentioned to show that no one should be discouraged by repeated failures in using Watson's method, but should keep on persevering in his attempts.

At the Bee Culture Laboratory up to the present time efforts to employ any method for artificially inseminating queenbees have been directed largely toward becoming more proficient in its use, and toward improving the method of technique, because in the meanwhile other phases of a program begun in 1925 and having to do with a study of various races of the honeybee have been in progress. A paper arising from this work was presented before this section last year.[1]

All of the queenbees used by the writer in 1927 in the work on artificial insemination were either reared above excluders in hive-bodies from which there was no escape to the outside before these queens were removed by the writer, or else they emerged in Alley nursery cages. All the queenbees used in 1928 emerged in the nursery cages. Before treatment the wings of each queen were clipped and after treatment the queens were introduced into hives from which their escape to the outside was cut off by means of excluders. In this way they were given no chance to fly outside and mate. Since the queenbees treated at the Laboratory were experimented upon for practice only, there was no need of knowing either their ancestry or that of the drones used in the experiment.

In 1927 twenty queens were treated by Watson's method. Of these treatments one was completely successful. The queen in this instance was artificially inseminated in the latter part of June, and was introduced into a 4-frame nucleus. Within six days after being released by the bees she was laying. Her brood when sealed proved to be all worker brood. She soon had four frames nearly full of brood. It was the intention to keep this queen over winter in a normal colony and to photograph her brood the next year so as to make a comparison of brood-rearing activity in her colony with that in colonies headed by

[1]Nolan, W. J. Seasonal Brood-Rearing Activity of the Cyprian Honeybee. Journ. Ec. Ent. 21:392–403. illus. 1928.

normally fertilized queens. She was successfully introduced into a strong colony early in August, but late in September some sealed drone brood appeared, and this gave rise to the suspicion that her supply of spermatozoa was becoming exhausted. The normal seasonal cessation of brood-rearing came too soon afterwards to verify this suspicion. The queen wintered all right but, as was feared, a preponderance of drones resulted from her early brood-rearing activities in the spring, and by the beginning of April over 90 per cent of the eggs which she laid proved to be drone eggs. The queen was removed shortly after this.

It happens that this queenbee was the first with which the writer had success in using Watson's method, and was also the only one in 1927 which began its career by laying only worker eggs. Of the other 19 queens treated, positive results were shown in the cases of only 4. One of these showed about a 50 per cent insemination, based on an estimation of the percentage of the brood as it emerged which was composed of worker bees. Insemination in the cases of the others was below 10 per cent, and in one of them even below 5 per cent. No attempt was made to winter these queens, although they survived in the nuclei for some time.

In 1928 the experiments were conducted for only about six weeks. At this time both Watson's method and Quinn's method were used. About ten queens were subjected to the Quinn method, and six to Watson's method. No success resulted from the use of Quinn's method, although it was not found difficult to cause the drone's organs to evert in such a way that they were retained by the queen when they were cut loose from the drone. Evidently, however, they were not in the proper position for the transfer of spermatozoa. The Quinn-Laidlaw method seems a more natural and is a less mechanical method than Watson's, and therefore apparently requires more practice before success is attained. Since the queenbees mentioned here are the first on which he has experimented with the Quinn method, the writer is waiting an opportunity to try it further before expressing any preference as to either method.

Three of the six queenbees subjected in 1928 to Watson's method showed on the emergence of their brood that insemination had been accomplished to a greater or less degree. The emerged brood of one queen indicated that the treatment was 100 per cent successful in her case, while for the other two queens it indicated that the treatment was over 70 per cent successful. As the writer was absent from the Laboratory for a couple of months shortly after the first brood from

these queens was sealed, and as neither the queens nor the drones were from known stock, no special effort was made to keep the queens.

The queens reported here as being treated successfully were subjected to only one attempt at insemination, and the same statement holds for the unsuccessful attempts. Watson, on the other hand, reports[2] in 1927 that "During the season 96 virgin queens were treated from one to ten times each, depending on their behavior. Of this number 66 per cent received 1 per cent or more of the normal degree of insemination, and 34 per cent received practically no sperms into the spermatheca." In a number of instances of the unsuccessful use of Watson's method by the writer in 1927, the queens began attempts to lay soon after being introduced subsequent to the treatment. They were seen to back into cells on successive days and to attempt to lay, but no eggs were discovered. In one such case eggs were found on the sixteenth day. Practically all of these queenbees began to lay sooner or later, but, of course, proved to be only drone layers.

On a number of occasions Doctor Watson has referred to a fairly heavy loss after introduction of queenbees which he has treated. This is the reverse of the writer's experience, because nearly every queen bee treated by the writer, whether successfully or not, survived as long as did the nucleus in which it was placed. It may be stated that in all cases the writer introduced these treated queens into nuclei varying from 3 to 5 frames in strength except on one occasion when a treated queen was introduced into a full-strength colony. She proved to be uninseminated, although there was some doubt as to six sealed cells from which bees did not emerge. This queen was allowed to remain in the colony for three weeks, however, before she was removed and a normally mated queen introduced to save the colony.

Watson[3] in his book (p. 43) further reports apparently that his queens commence to lay within about the same period after being artificially inseminated as if they had been inseminated naturally. The writer, on the other hand, has not had this experience so far. In the case of the successfully inseminated queen in 1927 the first eggs appeared nearly one week after insemination. The same applies to the three 1928 queens mentioned in this paper. It may be mentioned that the 1927 queen was 10 days old when inseminated. Watson states in his book that he has been successful in inseminating queens even much

[2]Watson, Lloyd R. Controlled mating in the honeybee. Report of the Iowa State Apiarist, 1927, p. 36–41, illus.

[3]Watson, Lloyd R. Controlled mating of queenbees. 50 p. 11 fig. 1927.

older comparatively. Quinn, in the Bee World for October, 1923, stated that he had "hand mated" a queenbee 30 days old.

The queenbee successfully treated by the writer in 1927 was the daughter of a German "brown" queen which had been obtained from one of the leading queenbreeders of Germany. The worker sisters of this treated queen gave no indication that their imported queen parent had been mismated and all observed drones from both imported mother and treated daughter seemed typical of the German "brown" race. The sperm used in the insemination of the treated queen came from a yellow drone. The coloring of the abdominal tergites of her worker progeny in the F_1 generation could easily have led the casual observer to believe that these workers belonged to a dark strain of three-banded Italians. No all black or all yellow workers were noted in this generation.

Watson (Report of Iowa State Apiarist for 1927, p. 40) reports that the F_1 workers of a cross between a black virgin and a yellow drone showed superficially no trace of yellow blood, but were black, and "full images of their mother's sisters." On the other hand Newell reported (Sci, N. S. XLI, p. 218–19) in 1915, "In the reciprocal cross, in which Carniolan queens are mated to Italian drones, the yellow color is also dominant, but not as completely so as in the primary cross: the F_1 queens and workers show nearly, but not quite, as much yellow color as the parent Italian stock."

Each of the three black queens just mentioned belonged to a different race if the black queen used by Watson belonged to the Dutch race. This may have been the case since some authorities hold that the black bee common in this country is the Dutch bee. Whether the differences in the foregoing results bear any relation to the difference in the races to which the queens belonged can not be decided from the data presented here since the writer's observations, at least, were confined to the progeny of only one queen and were the result of chance rather than of design. It is interesting to note, nevertheless, that in the silkworm both a dominant white factor and a recessive white factor have been reported, while in three different races of white poultry a different factor for white is held present in each.

It is well to bear in mind that cytological evidence available up to the present indicates that at all stages the germ cells of drones have the haploid number of chromosomes. Such a condition would in itself simplify breeding problems with the honeybee, in certain respects at least, since it eliminates the question of any individual drone being heterozygous in the ordinary sense of the word.

Certain modifications in the apparatus for the Watson method were tested out at the Bee Culture Laboratory during 1928. One of the most important of these does away with the operating table or block used by Watson and also by Prell, as well as with the necessity of binding the queen to the block by wrapping her with threads. Quinn, in his method, also binds the queen with thread. In place of this procedure Mr. Hambleton has devised the use of a small glass tube about 1½ inches long and of diameter just sufficient for the queen to back into it. One end of the tube is sealed over just sufficiently to allow the tip of the abdomen of the queen to extend beyond the tube when she is backed into it. The queen is held in place in this tube by "corking" it with another glass tube, which just fits inside of the first. The two are then wedged by a splinter of wood. Needless to say, the use of such a tube is far more convenient than wrapping the queen with threads. It also speeds up the operation considerably and is a great aid to clumsy fingers as well as to the queen. Furthermore little danger exists of injuring her while she is in the tube, at least provided she is not kept there longer than sufficient for accomplishing the insemination under proper conditions. If the queen is kept in the tube for a much prolonged period, however, moisture may condense to such an extent that she will become thoroughly drenched.

In order that the tip of the abdomen of the queen may be placed at the proper angle the tube is mounted on one of the faces of a small triangular wooden block. The angle between any two of the three faces of this block differs in each case so that the angle of elevation of the tube may be varied depending on which face the block is resting and on which of the other two faces the tube is attached. The tube may be quite easily mounted on a rod in such a way that by turning the rod by a thumb screw, or otherwise, the tube may be elevated to any desired angle.

Another modification is one which does away with the necessity of holding open the tips of the queen's abdomen by means of a forceps held in the hand during the operation, as in Doctor Watson's original method. This is accomplished instead by means of a small U-shaped clip, made of a piece of fine wire and bent into a right angle at each end to form a small prong. These prongs are held apart by the spring formed by the bend in the wire. When the prongs are adjusted between the tips of the queen's abdomen, the whole clip is supported by the pressure of the prongs pushing out against the tips of her abdomen. The width to which these prongs may be spread is adjusted so as not to be suffi-

cient to injure the queen in any way and yet to allow sufficient room for the introduction of the micro-pipette. Furthermore, the use of this clip does away with misplacing the sting palpi, which sometimes happens when forceps are used. It also does away with the danger that the sting will be caught in either tip of the abdomen. The clip was first suggested by Dr. L. C. Spencer, of Louisiana. It is interesting to note that the three successful inseminations achieved in succession in 1928 with Watson's method were those of queenbees treated by this modified equipment.

Another great convenience is the use on an extension arm of some one of the telescope binoculars now on the market. These allow a much greater working distance than do ordinary binocular microscopes, and do away with a microscope stand between the body of the operator and the apparatus with which he is working.

ADMINISTRATIVE PHASES OF TEACHING, RESEARCH, REGULATORY AND EXTENSION ENTOMOLOGY.[1,2]

By THOMAS J. HEADLEE, Ph.D., *New Brunswick, N. J.*

ABSTRACT

The best results in teaching, research, regulatory and extension entomology are likely to be obtained where all these lines are united under an adequate administrative head who has a vital interest and wide experience in the second, because such union is apt to eliminate undesirable duplication and its attendant ills and at the same time to assure an administrative head who is fundamentally interested in the science of entomology. Nevertheless the form of organization makes very little difference in accomplishment if the workers are thoroughly interested in entomology and thoroughly imbued with the proper ideals of public service.

When this subject was assigned to the writer he spent some time wondering why, and then it occurred to him that the assignment must have been made because he had the misfortune of occupying a bench instead of a chair. He is in the position of the general farmer with a larger acreage than he can personally attend, while the other speakers in this program are in the position of the farmer with a small acreage to which he can give close personal attention and from which he can expect large returns.

Of course the answer to successful conduct of teaching, research, regulatory and extension entomology lies in the ability of the adminis-

[1]Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

[2]Read before the Section of Extension.

trator to pick adequate lieutenants and to secure funds for their salaries and activities. If he can meet these two primary conditions he can conduct with reasonable success work along the lines of teaching, research, regulatory and extension entomology. Granting his ability to secure men and funds the principal difficulty lies in the old principle that "no man can serve two masters etc." He is fortunate indeed if while having a primary interest in some one line, as the writer has, or thinks he has, in research, he can prevent the primary interest from overshadowing and weakening the other lines. Of course he can be purely administrative, but if he is so he is likely to place emphasis upon the administrative side and lack sympathy with the actual work. The writer has seen the two types of administrative officers as directors of experiment stations and is convinced by more than twenty years experience that the purely administrative man cannot compare in the results obtained by the organization working under him with the man who has a primary interest in some one of the lines.

In dealing with the lieutenants it is of prime importance that the lieutneant be allowed wide latitude and he be not forced to do this and that according to the administrative officer's slant, for if he is worth his salt failure to allow him this latitude will destroy his initiative and make him an automaton.

A very great disadvantage of assembling many lines of work under one man is that normally the financial support for the combined lines will be little, if any, greater than the financial support for any one of the lines if they were separate. On the other hand combination of various related lines under one man permits the accomplishment of more service for the dollar of expenditure because of better intergration of effort and the prevention of the appearance of active jealousy. The latter we all know in many cases serves practically to annul or at least greatly to reduce the efficiency of the prosecution of the same lines by separate and independent organizations.

All advantages and disadvantages considered the writer is of the opinion, after having worked for many years with both separated and united lines of effort of this kind, that the service rendered by the organization in which these closely related lines are united is better from the standpoints of both quality and quantity of work accomplished.

So much for the question of organization best adapted to secure efficient results in teaching, research, regulatory and extension entomology. There is an additional factor perhaps of greater importance than any which have been hitherto set forth—greater in the sense that

in its absence, no matter what the mental and financial equipment may be, satisfactorily efficient results cannot be secured. This factor is the attitude of wholehearted service to the best interests of the public which includes, among other things, the willingness to accommodate oneself to the conditions under which one must work to accomplish the true public service ideal. In New Jersey we have no extension entomologists as such, but do extension work either directly or through extension specialists in the production lines. So long as the spirit of true public service obtains the writer cannot see that the form of organization under which the entomologist works can, in any way, interfere with the accomplishment of maximum results.

EXTENSION ENTOMOLOGY IN RELATION TO RESEARCH

By V. I. Safro, *Trenton, New Jersey*[1]

Abstract

A discussion of the relationship in the choice of the problem, financial support, conduct of investigation, and interpretation of results.

The key word of the profession of Economic Entomology should be "Service." That is what the word "Economic" means. The greatest service necessitates constant and close contact between Extension Entomology and Research. Such contacts are here discussed under the following research relationships; choice of problem, financial support, conduct of investigations and interpretation of results.

Choice of Problem. The choice of a problem in economic entomology should be guided by the needs of the constituency that the research is intended to serve. It presupposes a knowledge of the needs of the people. This knowledge is obtained by contact with them and their problems—and such contacts are in the domain of Extension Entomology.

Unfortunately the interests of the constituency and the interests of the research investigator do not always coincide. Extension Entomology through necessity for adequate replies to questions of interested people is frequently in position to suggest lines of research that would tend to harmonize research tendencies with community needs.

Research for the sake of pure research might well be supported by permanent endowments. The public is more interested in research for the benefit of the constituency—and the wishes of the public can

[1]Read before the Section of Extension.

well be considered in such matters as the choice of a problem. Extension Entomology appreciates the need for fundamental research. At the same time it realizes the needs of the community being served and the intent of appropriations made for specific purposes. Hence it is in position to indicate the tendencies when the research pendulum swings too far away from direct problems calling, perhaps, for more immediate attention.

FINANCIAL SUPPORT. Financial support is an integral part of the research program. And here Extension Entomology can perform invaluable service. Entomology is for the most part a subsidized profession, supported by funds obtained through Government, State, and in some cases local taxation.

Extension Entomology is in direct contact with the sources of the funds. The relationship of the Extension Entomologist to his public is likely to have a very definite influence upon research support. It may help or it may hinder such support.

The taxpayer may not be a judge of scientific values or scientific procedure. His judgment may be entirely wrong. Extension Entomology is often in position to correct such judgment—and it must be done sympathetically, courteously, in language and with logic that can easily be understood. In fact, Extension Entomology in its position to present the claims of Economic Entomology for continued support frequently serves as a liaison agent between the public and the research, often guiding the extent and nature of the support.

CONDUCT OF THE INVESTIGATIONS. The research worker tends usually to become a specialist. The extension worker is usually a general practitioner. Constant contacts and discussions between the two should be mutually helpful.

Conditions change, problems change, and Extension Entomology is in position to learn of such changes and communicate them to Research for whatever salutary effect it may have upon the conduct of the investigations.

To Research time is likely to be incidental. To the constituency it is likely to be all important. It is one of the functions of Extension Entomology to harmonize such differing view points and to give them a reasonable relative importance without injury to the quality of the investigational work.

Finer discernment is being shown on the part of the public as regards research work. Interested men are beginning to understand investigational procedures. This is evident in the demands of growers for

definite investigational projects and for periodic reports upon results accomplished.

Extension Entomology appreciates the value of negative results. A failure to obtain a practical answer, admitted and frankly announced may be the economic answer that is needed. If the problem of the control of a certain pest of an agricultural crop is unsolved after considerable research, Extension Entomology, as a result of a survey of the situation, may suggest that for the present it may be advisable not to grow that crop.

Interpretation of Results. Extension Entomology has as its greatest activity the "selling" of the results of Research to the public. This calls for the interpretation of such results and their demonstration as bases for practical procedures. Interpretation is here used in its broadest sense. It includes adaptation to local conditions, correlation with other practices, coordination with conflicting results obtained elsewhere, and even modification to obtain the best results the specific situation permits.

Research may indicate the best methods of controlling an insect pest. Actual local conditions may induce Extension to use the second or third best method.

One important phase of economic entomology has for too long a time been consistently ignored by investigators. That phase is human psychology. Economic entomology may even be defined as the study of insects in their relation to human psychology.

The preferences of people, whether logical or not, must be given due consideration in determining the most advisable procedure to follow. Extension Entomology ascertains the relative value of the time and convenience of the people.

Is it cheaper to make an insecticide than to purchase it? That depends upon the valuation the individual places upon his time, labor and convenience. Is it always advisable to make that last spray application to obtain the last three per cent control? Extension Entomology answers "not always." Is spraying and a consequently possible 100 per cent control always to be preferred to dusting with a possible lower percentage control? Extension Entomology answers "not always." Are control measures always advisable as against sustaining losses caused by uncontrolled insects? Extension Entomology answers "not always."

The justification for Economic Entomology rests in the acceptance by the public of its recommendations. It is the function of Extension

Entomology to place those recommendations in acceptable form. Shall modern power machinery be used in place of hand labor? Extension Entomology replies "it depends upon the supply of labor, its cost, and its efficiency." Must the cost of insect control always be less than the value of the material being protected? Extension Entomology replies "under some conditions it may be greater and still be advisable."

Extension Entomology may not have imposing technical publications to offer to the entomological profession, it may have no new and unusual observations to record, it may have no entomological priorities to receive credit for; but it has in truth a great function, the function of Service. Service to the public and service as a helper, friend, and advisor to Research Entomology.

SOIL TREATMENT FOR CONTROL OF THE JAPANESE BEETLE

By Ernest N. Cory and P. D. Sanders

Abstract

The State of Maryland, in cooperation with the Plant Quarantine and Control Administration, conducted a campaign of soil treatment with carbon bisulphide emulsion during 1927 and 1928 in a large scale experiment on the suppression of the Japanese beetle, *Popillia japonica*. The methods developed so successfully by the Japanese Beetle Laboratory for the control of grubs in golf greens and balled nursery stock were followed. A total of 3,851,489 sq. ft. in six towns and Baltimore City were treated at an average cost of $194.79 per acre.

During the year of 1927 and 1928, the State of Maryland has been engaged in a campaign of soil treatment with carbon bisulfide emulsion for the control of the Japanese beetle grubs in the areas where scouting revealed the presence of beetles during the previous flight periods. This work has been done in cooperation with and under the supervision of the Federal officers in charge of Japanese beetle control, and thanks are due them for their help in the work.

The scouting of the summer of 1926 disclosed the presence of only two beetles in the State. These were found in Loudon Park Cemetery on the western edge of Baltimore City in September. The Soil treatment with carbon bisulphide emulsion has been developed by the Japanese Beetle Laboratory for the treatment of golf greens and balled nursery stock. This treatment has been reported so effective when applied under proper conditions, that it seemed to the writers that the State of Maryland should avail itself of this protective measure in its attempt

to hold back as long as possible the beetle invasion. This area was treated in the Spring of 1927. The intensive scouting of the season of 1927 failed to reveal any beetles in the cemetery but did show the presence of beetles in northern Baltimore, Chesapeake City, Perryville, Ridgely and Cambridge. Still believing that the battle to retard the spread of the Japanese beetle should be waged most vigorously on the actual frontier, the State of Maryland appropriated funds for soil treatment in the five places mentioned above. The soil treatments were accordingly made in the fall of 1927 and the spring of 1928. Scouting during the past season has revealed the presence of the Japanese beetle in four of the places named above, and in several additional places in very limited numbers. We still believe that the fight to prevent the increase and spread of these insects should be continued vigorously by soil treatments supplemented by the operation of large numbers of geraniol traps and any other method that may show some probability of decreasing the numbers of the beetles that escape the combined action of the soil treatment and the trapping campaign.

It seems inevitable that the State of Maryland will ultimately become generally infested, but it is hoped that a retardation of the spread in the State and beyond the borders of Maryland may result from the treatment campaign. The indications are that the natural rate of increase has been checked by these control methods and that the day when Maryland farming interests will have to combat this pest has been materially postponed. By the time that individual efforts become necessary it is our belief that more efficient methods of control will have been worked out by those studying this problem, and that the splendid start towards biological control will be much further advanced.

Throughout the treatment campaign the carbon bisulphide was used at the dilution of 1 gallon of stock emulsion to each 200 gallons of water and applied at the rate of 3 pints of diluted solution to each square foot of soil surface. In level well sodded areas this quantity soaked in readily in two applications, but in harder and heavier soils three applications were almost always necessary. Where the surface was uneven or the solution applied too rapidly and puddling resulted, injury to vegetation usually followed within a week. No serious damage to plants was done in the course of the Maryland work but numerous cases of slight injury were observed. All the treatments were made when the soil temperature was above 40°F. and the soil sufficiently dry to take up the solution.

Two types of apparatus were used in the soil treatment. In the first work in Loudon Park, a high power sprayer was furnished by the Japanese Beetle Laboratory. This was equipped with a manifold that supplied four lines of hose terminating in the fan-shaped nozzle developed for soil treatment. In the work at the other points during the fall of 1927 and the spring of 1928 I. P. Thomas proportioners were used. Water under pressure, was obtainable in all of the areas except at Chesapeake City. At that point water was pumped directly to the proportioners from a pump scow in the Delaware and Chesapeake Canal. The services of the pump and operator were contributed by the Office of the District Engineer of the War Department. Proportioners of 600 and 1200-gallon capacity per hour were used, the former giving the most satisfactory service. Two laborers were required for the operation of each proportioner, one to move the hose, while the other did the actual spraying. In addition to the men operating each proportioner, two men were required for each eight proportioners to keep them supplied with the concentrated emulsion. A specially trained supervisor was required for each two proportioners to keep a constant check on their performance and to keep records of the area treated and other details in connection with the work. The work in the fall of 1928 was done entirely with the sprayers loaned for the work by the Plant Quarantine and Control Administration. These sprayers were of 600-gallon capacity. Four leads of hose were used on each sprayer, requiring eight men in addition to the engine man and the general supervisor.

From the limited experience that we have had, we believe that the use of sprayers in soil treatments is to be preferred to the use of proportioners for the reason that the dilution in the spray tank is absolutely accurate and constant, and because a larger amount of material can be put out per day than by the use of proportioners. Moreover the number of square feet covered can be more accurately determined. The main difficulty with the proportioners was that the dilution adjustment was too crude to be accurately adjusted by the dial, making it necessary to check on the dilution with a measuring stick after each movement of the valve. This was especially disturbing where small backyards were being treated necessitating frequent shut-downs on the water flow. Proportioners are easily clogged up with foreign matter that happens to get in the water.

At Loudon Park Cemetery, which lies adjacent to the Frederick Road Station of the Pennsylvania Railroad, an area of approximately five acres was laid out to be treated for each of the two beetles found

by scouts in September, 1926. The point where the beetles were picked up was taken as a center of the area to be treated. The water supply was at a distance of about one-quarter mile from the farthest area treated, so considerable time was consumed going to and from the ground that was being sprayed. 378,390 square feet were actually covered. Approximately 434 gallons of carbon bisulphide emulsion were used; Total cost of emulsion, $900. (Some unused emulsion lost due to its instability.) The total cost for the treatment at Loudon Park, including emulsion, $900, labor $489.68, travel and supervision $172.42, gas and oil $62.27, equipment $175 and drayage $10.00, not including salaries of supervisors amounted to $1,809.37.

Soil Treatments in Spring of 1928. Treatment was made at Ridgely, Chesapeake City, Baltimore and Perryville during the spring of 1928. Work began on April 17 at Ridgely. 217,784 square feet were treated in the town by the use of proportioners. Likewise proportioners were used in the other spring work at Chesapeake City, Baltimore and Perryville. On May 1 work was started at Chesapeake City, the water used being pumped from the Delaware and Chesapeake Canal directly into the hose lines. 455,938 square feet were treated. Areas on each side of the canal received attention. At Baltimore, where an operating crew began work on May 4, the work was done in cooperation with the City Water Department, who furnished water without charge, and laborers and supervisors, for which the city was reimbursed by the State. 940,005 square feet were treated, most of which was in small backyards, which were exceedingly difficult to treat satisfactorily. At Perryville work was begun on June 8, which was probably too late, under Maryland conditions, for successful treatment. Water from the town hydrants was used here and 216,326 square feet were treated.

Soil Treatments in the Fall of 1928. In Cambridge eleven beetles were found in five places, all of which were treated in the fall of 1927. In the scouting of 1928, fifteen beetles were found in five places, with one exception, all in the same general neighborhood that was treated the previous year. This area has been treated again during the fall of 1928, using sprayers; five tons of carbon bisulphide emulsion were used. This covered 549,000 square feet. The total cost for the treatment at Cambridge was $2,556.30 divided as follows: Emulsion $1,700.00; labor $537.50; hauling $50.00; equipment, hose, etc. $268.80. A total of 12½ days was consumed in completing the treatment at Cambridge.

At Delmar, half of which is in the State of Delaware and the balance in the State of Maryland, beetles were picked up by the scouts at six

places. The treatment began on the 9th of November. Eight tons of emulsion were used in covering a total of 680,133 square feet. The cost, apportioned as follows, was: Carbon bisulphide $2,040.00; labor $745.80; miscellaneous expenses $112.84; making a total of $2,898.64.

Summary

1. The soil treatment with carbon bisulphide emulsion has been the principal method of fighting Japanese beetle spread in Maryland up to the present time. In the flight season of 1929, this will be supplemented by an energetic campaign of trapping with geraniol baits.

2. Up to the present time the total cost of these operations amounts to about $23,000. This includes some items of salary not specifically mentioned in the detailed accounts of the work. However, practically all of the supervision and overhead has been absorbed by other than the above funds.

3. No beetles were found at Ridgely during the scouting season of 1928, subsequent to the treatment of approximately five acres in that town in 1927. At Cambridge, Maryland, fifteen beetles were collected in 1928, as compared with thirteen the previous season. At Chesapeake City, a total of 213 beetles was found by five day's scouting, running from July 2 to August 30, as compared with 97 beetles picked up in two days' scouting the previous season. In Baltimore, in two areas that received treatment under the most favorable conditions no beetles were found by most careful scouting this year. However, in the general area near the freight yard and at the points where the last work of the season was completed during the early part of June, a general infestation seems to be present, judged by the findings of the scouts. This is also true of the Perryville section where work was finished on June 14, which was probably too late for most effective work.

4. This work seems to indicate that the natural rate of increase of the Japanese beetle has been reduced, assuming that soil infestation was present in each area treated, with the exceptions noted. Even in the Baltimore area, where the treating was done under the greatest difficulties and where more beetles were found by the scouts this year than in the previous season, it is probable that a considerable percentage of the grubs were destroyed by the treatment.

5. Sprayers have given much more satisfactory treatment than proportioners, due to their accuracy in dilution and application and greater capacity per day.

Cost* of Soil Treatment

	Loudon Park	Cambridge 1927	Ridgely	Chesapeake City	Baltimore	Perryville	Cambridge 1928	Delmar
Cost per acre	$256.13	$144.40	$145.05	$162.91	$299.69	$161.17	$203.42	$185.57
No. of sq. ft. treated	278,390	513,913	217,784	455,938	940,005	216,326	549,000	680,133
No. of sq. ft. the emulsion used should have treated	244,800	419,200	204,266	434,133	829,333	206,400	549,333	679,840
No. of sq. ft. treated in excess**	33,590	94,713	13,518	21,805	110,672	9,926	333	293

*Does not include supervision.

**The use of proportioners was responsible for the discrepancies in the number of square feet treated over the area that should have been treated. Reasons for this are given in the text. At Loudon Park the discrepancy is more apparent than real, due to stone slabs etc., not excluded from the tabulation.

Soil Treatments in 1927 and 1928

	Loudon Park	Cambridge	Ridgely	Chesapeake City	Baltimore	Perryville	Cambridge	Delmar	Total
1. Work begun	May 23, 1927	Nov. 4, 1927	Apr. 17, 1928	May 1, 1928	May 4, 1928	June 8, 1928	Oct. 22, 1928	Nov. 9, 1928	
2. Work finished	June 17, 1927	Dec. 1, 1927	Apr. 27, 1928	May 23, 1928	June 7, 1928	June 14, 1928	Nov. 7, 1928	Dec. 5, 1928	
3. Days lost, wet grounds	1½	6	2	4	10	½	1½	9	34½
4. Working days	21½	16	5½	15	20	5½	12½	11	107
5. Labor costs	$489.68	$279.24	$107.50	$331.75	$2 825.68	$161.00	$537.50	$745.80	$5,478.15
6. Hauling cost	$ 10.00	$ 25.24	$ 18.00	$ 25.00	$ 37.50	$ 40.00	$ 50.00	0	$205.74
7. CS_2 costs	$900.00	$1,200.00	$600.00	$1,200.00	$2,720.00	$600.00	$1,700.00	$2,040.00	$10,960.00
8. Other material costs	$237.27	$199.59	0	$149.25	$885.03	0	$268.80	$112.84	$1,852.78
9. Water obtained from	Pond	City fire plugs	City fire plugs	Pump scow	City fire plugs	City fire plugs	City fire plugs	City fire plugs	
10. Average length of day	8 hours	9 hours	9 hours	9 hours	9 hours	9 hours	8 hours	8 hours	
11. State supervisor days	5	32	14	28	38	13	22	39	191
12. Federal inspector days	21½	16	6	15	25	6	34	58	191½
13. Truck days	21½	0	0	0	40	0	23**	21**	105½
14. Truck driver days	23½	0	0	0	40	0	28***	47***	
15. Laborer days	172	176	35	102½	312	59	190½	190½	1,237½
16. Gallons CS_2 used	459*	786	383	814	1,555	387	1,030	1,269	6,683
17. Gallons solution used	99,900	193,980	80,722	172,427	353,418	79,227	206,400	253,800	1,439,924
18. Sq. ft. area covered	378,390	513,913	217,784	455,938	940,005	216,326	549,000	680,133	3,851,489
19. 600-gal. proportioner days	21½**	46	11	29	110	15	0	0	232½
20. 1200-gal. proportioner days	0	9	5	14½	6	5	0	0	39½
21. Average temperature, 3″ 8 A. M.		48°	48°	58°	62°	69°	54°	44°	
22. Average temperature, 3″ 12 M		45°	52°	62°	68°	73°	58°	48°	
23. Average temperature, 9″ 12 M		—	52°	57°	66°	72°	57°	48°	
24. Average temperature, 3″ 4 P. M.		50°	59°	68°	72°	77°	58°	48°	

*Twenty-five gallons wasted by vandals.
**This represents sprayer days as no proportioners were used in the spring of 1927 and fall of 1928.
***Sprayer driver days.

TRAPPING CALOSOMA BEETLES

By C. W. COLLINS and J. E. R. HOLBROOK, *U. S. Bureau of Entomology, Melrose Highlands, Mass.*

ABSTRACT

A trap has been developed for ascertaining the density of the population of *Calosoma sycophanta* L. and incidentally other tree-climbing beetles. The possibilities of its use in collecting *Calosoma sycophanta* beetles on a large scale for colonization are discussed.

Calosoma sycophanta L. was first introduced into eastern Massachusetts from central Europe in 1906 and recovered as a result of colonization in 1907. Further distribution was effected through later shipments and rearings at the Gipsy Moth Laboratory, and also through collections made in those sections of New England where the species had become thoroughly established. It now occurs generally in parts of New England where the gipsy moth (*Porthetria dispar* L.) has increased to such proportions that it is a commonly recognized pest.

During the years 1912 to 1920, when large numbers of adults of *C. sycophanta* were wanted for colonization purposes in the territory infested by the gipsy moth in New England, these were collected by kicking with the foot the smaller trees where the beetles abounded. Trees that were 6 or more inches in diameter could not be sufficiently jarred by this method to dislodge the beetles, so later a padded window weight was used. It was necessary after jarring a tree and dislodging 3 or 4 beetles to grab these quickly before one or more of them were lost in the dried leaves beneath the trees. Two hundred or three hundred per man per day was considered good collecting, although as many as 1,231 were collected by 3 men in 5 hours in 1915, and on another occasion, in 1920, 158 beetles were collected by one man in an hour. Such collections were rather rare, as favorable conditions could be found only on certain warm days and in small oak growth with medium to heavy gipsy moth infestation. Diligent search was made for beetles in what seemed to be favorable locations on cool, cloudy, and dull days but with small returns. The beetles remain under cover on such days, the females probably ovipositing. Wrong impressions were often formed by collectors and observers as to the abundance of beetles in woodlands, owing to the fact that they were making their observations under adverse weather conditions. The large numbers of gipsy moth pupae later observed to have been destroyed by the larvae of *C. sycophanta* in the same sections would indicate that adults of the predator must have been abundant when the earlier observations were made.

During the winter of 1926–27 the senior writer conceived the idea of a trap to facilitate the work of obtaining population records and large collections of beetles. The mechanical details were worked out with the assistance of the junior writer, with helpful suggestions from others of the Gipsy Moth Laboratory. This is designated as the Calosoma Beetle Trap. The purpose of the trap is to obtain the count of the number of beetles to a tree or on a given portion of an acre. From laboratory experiments the number of *P. dispar* larvae and pupae destroyed by this number of beetles and their larvae can be estimated.

The traps were placed on trees (for the most part over 3 inches in diameter) on selected $\frac{1}{4}$ and $\frac{1}{8}$ acre plots in woodland areas in the gipsy moth infested territory of eastern Massachusetts. The trap is made of heavy jute tag manila paper stock which has been coated with paraffin for two purposes: to withstand the weather and to afford a slippery surface to which the beetles can not cling in their attempts to climb trees for food.

The container for the beetles is a tin can, 3½ inches in diameter and 4 inches deep, painted to prevent rust and to obviate the possibility of beetles getting a foothold and escaping by climbing up the side walls. Adults of *C. sycophanta* fly to some extent on hot humid days, but, although they can fly horizontally under the right conditions, they are unable to raise their weight perpendicularly by means of their wings. Hence they cannot escape from this container.

No attrahent is used in connection with this trap. Its value depends on the natural instinct of the adult and larval stages of *C. sycophanta* to climb in search of food. The larvae, being cannibalistic, cannot be held in captivity in numbers without irreparable losses; because of this, the trap is being developed to allow the larvae, when trapped, to pass out through holes near the bottom of the container.

The trap is giving a true index of beetle abundance under various conditions having to do with tree growth (which may or may not be conducive to their development), coupled with the rise and fall of gipsy moth infestations. As first developed, it consisted of a barrier band, 3 inches wide, placed diagonally around the tree, and a "skid plane" that was attached to the highest point of the barrier band. The skid plane measured 8 inches in width and 10 inches in height and was creased from top to bottom so as to divide it into 3 sections of approximately equal size. The central section rested on the bark of the tree and the side sections were bent outward at an angle of approximately 90°. Near the middle of the inside border of each side section was an

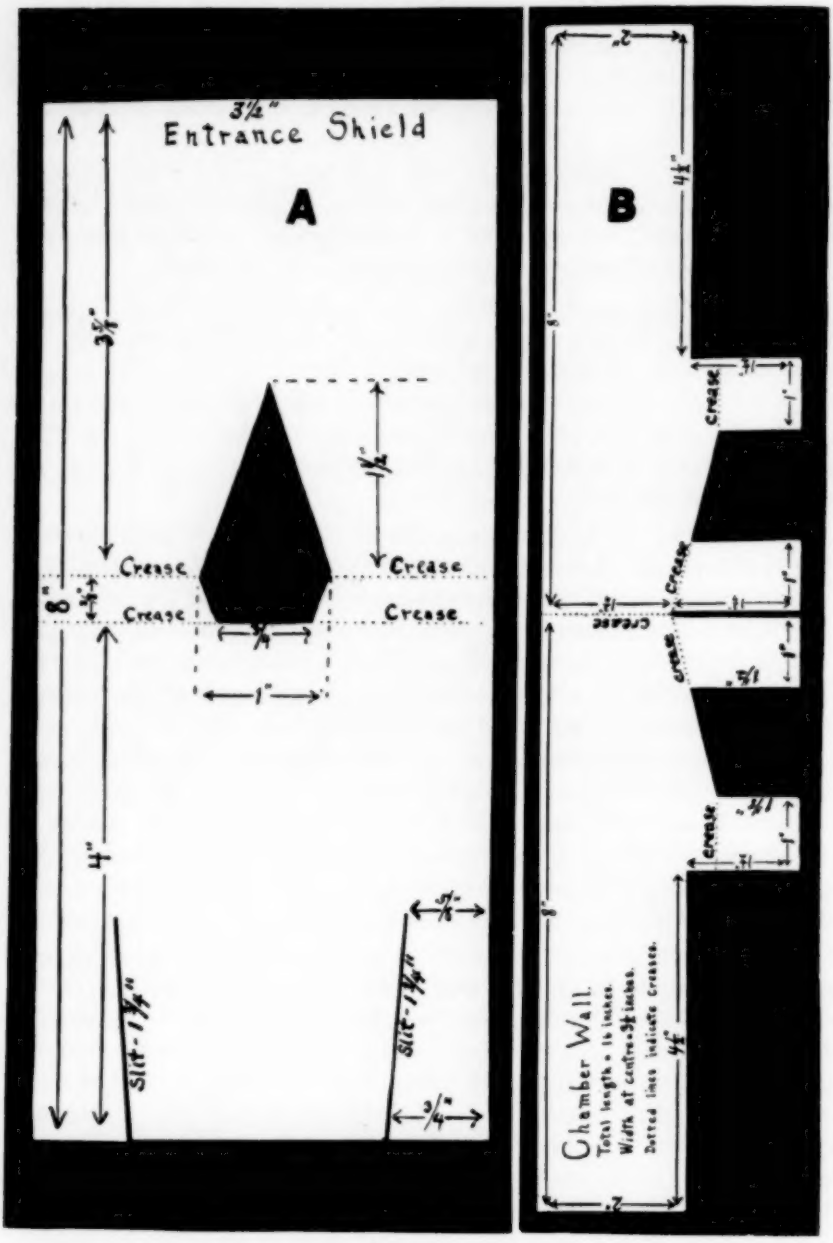


FIGURE 32. A, Calosoma Beetle Trap, showing entrance shield, dimensions and "cut out." B, Calosoma Beetle Trap, showing dimensions and design of chamber wall.

opening which was partially closed with flexible pieces of paper that were stapled to the section. The beetles, in their attempts to ascend the trees, opened these trap doors, which closed behind them and left them on the skid plane, to drop later into the container.

A marked improvement was made the second season by changing the design and reducing the size so that the trap could be more satisfactorily used on small trees. The improved trap consisted of three parts: the barrier band, the entrance shield, and the chamber wall. All were made of the same stock of jute tag manila paper. The form of the barrier band was not changed.

FIGURE 33. Showing Calosoma Beetle Trap, barrier band, chamber wall, entrance shield and container complete attached to tree.

The constructional details of the entrance shield are shown in Figure 32, A. The dimensions are 8 by 3½ inches. The shield is folded on the dotted lines marked "crease," causing the upper and lower sections to fall on parallel planes three-eighths of an inch apart and connected by the central section. The upper section has a triangular shaped piece removed and rests against the tree trunk. The central section has a piece removed which adjoins the base of the triangular shaped opening. This forms the hole through which the beetles enter the trap. The lower section is provided with 2 slits so that the portion between can be placed inside the container.

The constructional details of the chamber wall are shown in Figure 32, B. The dimensions of the paper form are 16 by 3½ inches. The wall forms a barrier which prevents beetles from ascending the tree after passing through the hole in the entrance shield and the pieces

that extend downward prevent them from falling outside the container. The four 1-inch projections are bent at right angles and are tacked to the tree to hold the wall in position. Figure 33 shows the barrier band, entrance shield, chamber wall, and container in place on a tree.

To test the efficiency of the traps in the spring of 1927, four oak woodland plots, measuring one-eighth or one-quarter acre each, were selected in eastern Massachusetts, in areas where the number of pupae of *P. dispar* eaten by larvae of *C. sycophanta* indicated that the predator had been in evidence the previous year. The trees upon which traps were placed averaged about 70 to a quarter-acre. The traps were visited and the beetles removed two or three times weekly. To illustrate, a summary of the notes regarding one trapped area is given in Table 1.

TABLE 1. *Calosoma sycophanta* BEETLE TRAPPING EXPERIMENT, WESTFORD, MASSACHUSETTS, 1928.

Traps placed in field, May 22, 1928.
Area covered with traps, ¼ acre.
Number of traps placed in area, 76.
Number of beetles trapped in ¼ acre, 760. Rate per acre, 3,040.
Infestation. During the spring of 1928 it was estimated that there were 6,000 egg clusters of *P. dispar* per acre in and about the plot.

Dates Traps Were Visited	Number of Beetles Removed From Traps	Males	Females
June 8	10	6	4
June 11	54	25	29
June 14	134	64	70
June 15	127	49	78
June 18	92	52	40
June 20	65	31	34
June 22	24	14	10
June 25	22	11	11
June 27	155	80	75
June 29	42	21	21
July 2	26	13	13
July 5	4	3	1
July 9	1	0	1
July 20	3	3	0
July 31	1	1	0
Totals	760	373	387

It was known that a rising gipsy moth infestation had been present near this location for at least three years and that heavy defoliation took place during the summer of 1927. An estimate of 6,000 egg clusters per acre was made in the spring of 1928. Defoliation during the latter year amounted to from 90 to 100 per cent in the plot, with practically

no egg deposition following. Fifty-two beetles were taken during the season at one trap on a single tree near this plot. One trap in a plot in Millis, Mass., caught 65 beetles in 1928.

In four locations the same areas were trapped for two years. The results, with those obtained in four other areas trapped in 1928, are shown in Table 2.

It will be noted (Table 2) that the catch of 1928 was much lower from three points (ranging from one-quarter to one-ninth as many beetles) as in 1927 and four times as large in another point in 1928 as in 1927. The figures indicate, however, that localities and conditions can be selected where a fairly good catch may be expected for at least two consecutive years. Such expectations are further borne out by the known habits of the beetles to live as long as four years in the adult stage and for a portion of them to remain quiescent in the ground without food for two winters and one summer during the second or third years of their existence. While it is admitted that *C. sycophanta* has rather low reproductive powers as compared to the entomophagous parasites of *P. dispar*, the former possibly remains somewhat longer in localities where there is a sudden decrease to almost disappearance of the host, and necessarily would disappear more gradually. An exception among the parasites would be *Compsilura concinnata* Meig., which parasitizes many species of hosts and survives independently of *P. dispar*.

Some data was secured in 1928 as to the cost of material used in the traps and the expense of preparing, applying, and visiting them. Labor costs were figured at $5.00 per day and estimates had to be made on some of the details, omitting costs for selection of locations and supervision. The information obtained is given below:

Cost of paper and preparing same	$ .025 per trap
Cost of cans and preparing same	.059 per trap
Installation in field (20 per hour)	.031 per trap
Care of traps in field—3 times a week for 5 weeks—to remove beetles	.312 per trap
	$ .427 per trap

The cans can be used for several years; hence the above costs could be reduced considerably if trapping were done on a large scale and over a series of years.

Five hundred and thirty traps in 1928 caught 2,629 beetles, averaging 4.96 beetles per trap and costing $.086 per beetle. At Millis, Mass., the average catch was 14.2 beetles per trap, or at a unit cost of $.03 per beetle. Two specimen trees attracted 65 and 52 beetles each for the season at a cost of $.0065 and $.008 respectively, per beetle.

TABLE 2. *Calosoma sycophanta* BEETLES TRAPPED IN 1927 AND 1928 IN PLOTS IN EASTERN MASSACHUSETTS, WITH INFORMATION REGARDING *Porthetria dispar* INFESTATION IN PLOTS.

Location of Plot[1]	Season of 1927				Season of 1928			
	Degree of *P. dispar* Infestation[2]	Estimated rate of Defoliation by *P. dispar*[2]	Number of Beetles Removed from Traps	Relative Number of Beetles per Acre	Estimated Number of *P. dispar* Egg Clusters per Acre[2]	Estimated Rate of Defoliation by *P. dispar*[2]	Number of Beetles Removed from Traps	Relative Number of Beetles per Acre
		Per cent				*Per cent*		
No. 1 Freetown...	Medium[3]	?	540	2,160	5	0	56	224
No. 2 Freetown...	Medium[3]	?	187	748	5	0	45	180
Lakeville.....	Heavy[3]	75	252	2,016	25	0	115	920
Boxford.....	Light[3]	0	77	308	200	10	299	1,196
Northboro.....					8,000	100	98	392
Lunenburg.....					3,000	65	212	848
Westford.....					6,000	100	760	3,040
Millis.....					1,000	25	1,054	4,216

[1]Except for Lakeville plot, which was 1/8 acre, all plots measured 1/4 acre, each

[2]The egg clusters and rate of defoliation have not been considered over large enough areas to have much significance in the case of these plots.

[3]Egg clusters not estimated in numbers.

The following species of Coleoptera were taken in the traps in varying numbers during the two seasons. At one point *Calosoma frigidum* was taken as abundantly as was *C. sycophanta*.

CARABIDAE
Calosoma sycophanta L.
Calosoma frigidum Kirby
Calosoma wilcoxi Lec.
Calosoma inquisitor L.—(In Gipsy Moth Laboratory yard—introduced but not established species)
Chlaenius sericeus Forst.
SCARABAEIDAE
Lachnosterna sp.
Euphoria fulgida Fab.
Gnorimus maculosus Knoch
TENEBRIONIDAE
Helops micans Fab.
Nyctobates pennsylvanica DeG.
SILPHIDAE
Silpha americana L.
Necrophorus tomentosus Web.
BUPRESTIDAE
Dicerca caudata Lec.
ELATERIDAE
Corymbites sp.

Under laboratory conditions it has been shown that, on the average, one pair of adults of *C. sycophanta* and their progeny will destroy about 6,000 larvae and pupae of *P. dispar* in a season. This predator under field conditions does not ordinarily destroy anywhere near all the larvae and pupae on the trees in a given infestation owing to the fact that even though the adults can and do climb to all parts of the trunk, branches, and twigs, the larvae are not able to do this and prey mostly upon pupae on the trunk and larger branches. The true parasites are more likely to parasitize an equal number of larvae of *P. dispar* from all parts of the tree. As high as 80 per cent of the pupae of *P. dispar* on the trunks and large branches of trees have been found to be destroyed by larvae of *C. sycophanta*. The average for the last six years was 24.6 per cent. The records also show that a similar average (24.6 per cent) of *P. dispar* larvae were destroyed annually by adults of *C. sycophanta* during the same period.

With the trapping experiments indicating that there may be as many as 4,216 beetles of *C. sycophanta* per acre in some woodland areas, and with as many as 65 beetles being trapped on a tree in a season (and this occurring where the gipsy moth infestation has risen to a point where a sudden decrease must necessarily follow), a problem for further investigation is suggested. This should consist of a study of the effects of the wholesale trapping of beetles in a locality where the gipsy moth infestation has reached or is about to reach its peak, and their transfer to distant areas where the infestation is much lighter and where the beetle population is small, not losing sight, however, of the effect of such changes on the effectiveness of the entomophagous parasites in the areas concerned.

NOTES ON PARADICHLOROBENZENE AND NAPHTHALENE AS REPELLENTS AGAINST CLOTHES MOTH LARVAE

By L. J. BOTTIMER, *Assistant Entomologist, Food, Drug and Insecticide Administration, U. S. Department of Agriculture*

ABSTRACT

Paradichlorobenzene and naphthalene, used in small quantities in a room of average size, were of no practical value as repellents against larvae of the webbing clothes moth, *Tineola biselliella*. In tests with each of these insecticides, more than one-half of the larvae concerned remained for two days within six inches of the material and were apparently uninjured.

Three series of tests with larvae of the webbing clothes moth (*Tineola biselliella* Hummel) were made in the Insecticide Laboratory of the Food, Drug and Insecticide Administration to determine the value of the common "moth repellents," paradichlorobenzene and naphthalene, under average living room conditions where a fumigation effect is not obtained. The first two series of tests were run in a room 9 feet by 16 feet by 10 feet on the first floor of a dwelling and the third series was run on the second floor in a room 13 feet by 13 feet by 8½ feet. As the tests were conducted during the winter months, the house was heated to a temperature ranging from 65 to 75 degrees Fahrenheit. These rooms received no direct ventilation from the outside during the tests, but the doors to adjoining rooms were kept open.

Two ounces (56.70 grams) of paradichlorobenzene were placed in a pile on a large sheet of paper. From the outer edges of the pile of material two slightly diverging lines were drawn. Between these two lines, at intervals of six inches, were placed six curved strips of flannel cloth, each an inch wide, representing arcs of concentric circles with the pile of material as the center. Thus, cloth A was six inches from the pile of paradichlorobenzene; B was 12 inches; etc., F being 36 inches away. To keep the larvae from escaping, tanglefoot was placed around the area including the strips of cloth and near, but not including, the paradichlorobenzene. Larvae were liberated within the banded area, between A and the insecticide, so that any repellent effect of the material would drive them toward F. The tests were made in a room having the windows heavily shaded to lessen the danger of affecting the behavior of the larvae by light. The results of these tests are given in Table 1.

In the foregoing tests 8 larvae were caught in the tanglefoot, 2 of them less than 6 inches from the paradichlorobenzene, 2 about 12 inches away, 3 about 18 inches, and one near E, 30 inches from the material. Four larvae were still crawling at the end of the 48 hours. In

TABLE 1. EFFECT OF PARADICHLOROBENZENE ON CLOTHES MOTH LARVAE EXPOSED FOR 48 HOURS AT DISTANCES OF 6 TO 36 INCHES

Test No.	Material volatilized in 48 Hours	Larvae under Cloth at End of 48 Hours[1] Strip A (6)	Strip B (12)	Strip C (18)	Strip D (24)	Strip E (30)	Strip F (36)	All strips
	Grams	%	%	%	%	%	%	No.
1	14.4	44	11	11	11	22	0	9
2	17.6	67	11	0	0	0	22	9
3	13.5	56	22	22	0	0	0	9
4	17.3	33	17	0	0	17	33	6
5	15.5	33	17	17	17	17	0	6
6	17.3	88	12	0	0	0	0	8
Aver.	15.9	54	15	8	5	9	9	47 (total)
Check	—	75	25	0	0	0	0	8

[1]The distance, in inches, of the strip from middle of pile of paradichlorobenzene is indicated by the number in parentheses.

the check one larva was found dead in the tanglefoot and one had not settled after two days. The results on these larvae are not included in the table.

The tests were repeated, using naphthalene as the repelling agent. The results are given in Table 2.

TABLE 2. EFFECT OF NAPHTHALENE ON CLOTHES MOTH LARVAE

Test No.	Material volatilized in 48 Hours	Larvae under cloth at end of 48 hours[1] A (6)	B (12)	C (18)	D (24)	E (30)	F (36)	All strips
	Grams	%	%	%	%	%	%	No.
1	1.6	67	17[2]	0	17	0	0	6
2	1.9	43	14	0	14	14	14	7
3	0.8	75	0	25	0	0	0	4
4	1.1	90	0	10	0	0	0	10
5	1.1	67	33	0	0	0	0	9
6	2.2	0	33	17	0	50	0	6
Aver.	1.5	57	16	9	5	11	2	42 (total)
Check	—	75	25	0	0	0	0	8

[1]The distance, in inches, of the strip from middle of pile of naphthalene is indicated by the number in parentheses.

[2]Larva injured, apparently from contact with tanglefoot

The results in Table 2 do not include those on 4 larvae that had failed to settle under the cloths and on 11 larvae that had been caught in the banding material. Of the latter, 9 larvae were less than 12 inches from the naphthalene, one was near C, and one was at D. The same check was used for both series of tests.

In the first series of tests an average of 15.9 grams of paradichlorobenzene volatilized during the 48 hours and 54 per cent of the larvae remained for two days under the strip of cloth 6 inches from the middle of the pile of material. In the second series an average of 1.5 grams of naphthalene volatilized in 48 hours, with a slightly less repellent effect, 57 per cent of the larvae remaining within 6 inches of the naphthalene. The larvae were apparently not injured by the insecticides. In most cases they had spun webs and were feeding.

In the third series of tests larvae were liberated within an 8-inch circle (A) of flannel strips one inch wide, and allowed to settle for 48 or 72 hours. Two ounces of paradichlorobenzene was then piled in the center of the circle and inch strips of flannel cloth were placed 16 inches from the middle of the pile of paradichlorobenzene, forming a circle (B) with a diameter of 32 inches. Larvae under A were not disturbed until the count was made, which was 48 hours after the paradichlorobenzene had been installed. The results obtained are given in Table 3.

TABLE 3. EFFECT OF PARADICHLOROBENZENE ON CLOTHES MOTH LARVAE EXPOSED FOR 48 HOURS AT DISTANCES OF 8 AND 32 INCHES

Test No.	Time Given For Larvae to Settle Hours	Material volatilized in 48 Hours Grams	Larvae Under Cloths 48 Hours After Material Was Added				
			A (8 inches)		B (32 inches)		All Cloths
			Number	Per cent	Number	Per cent	Number
1	48	16.7	1	20	4	80	5
2	48	15.7	6	86	1	14	7
3	48	10.3	3	60	2	40	5
4	48	22.1	6	67	3	33	9
5	72	8.9	6	86	1	14	7
6	72	18.4	9	69	4	31	13
Aver.	—	15.4	—	65	—	35	—
Total	—	——	31	—	15	—	46
Check	48	——	8	73	3	27	—

Larvae that were not under the cloth rings at the time counts were made and those caught in the tanglefoot band placed just beyond B were discarded and the results on them are not included in Table 3. At the time the paradichlorobenzene was added, a total of 13 larvae had not settled under A and a total of 11 were in the tanglefoot. Two days later only two larvae were in the open and none in the banding material. Two days after the check larvae were released, 4 larvae were in the tanglefoot and 2 had failed to settle under A. These specimens were removed, and 48 hours later all of the remaining larvae were still under the cloths.

In these tests, an average volatilization of 15.4 grams of paradichlorobenzene in two days was not sufficient to have any material effect in repelling larvae under normal living room conditions, as an average of 65 per cent of the larvae remained, apparently undisturbed and uninjured, under cloth strips at A within 5 inches of the middle of the pile of material. An average of 35 per cent of the larvae went to the outer ring of cloths after the insecticide had been installed and this is but little more than the percentage of check larvae that moved normally from A to B when no paradichlorobenzene was used.

When placed between a small unshaded window and an inch band of paradichlorobenzene, clothes moth larvae went toward the material and crossed it. In some cases larvae were in direct contact with the insecticide for 20 minutes and were apparently unharmed by it.

Conclusion

These experiments indicate that when used in very small quantities in living rooms, paradichlorobenzene and flake naphthalene are of little or no value as repellents for moth larvae.

WEATHER, A FACTOR IN OUTBREAKS OF THE HICKORY BARK BEETLE

By R. A. St. George, *U. S. Bureau of Entomology, Washington, D. C.*

Abstract

The contents of this paper indicates that weather has a marked effect on bark-beetle outbreaks. A hickory barkbeetle, *Eccoptogaster quadrispinosus*, outbreak occurred during the drought period of 1925 in North Carolina. The marked deficiency in precipitation weakened hickory trees by checking growth and rendered them attractive to beetle attacks, favoring brood development. An excess of precipitation during periods of beetle flight resulted in a partial mortality of the adults, thereby considerably reducing the number attacking and also rendered trees unfavorable for brood development.

Drought and Beetle Outbreaks

The influence of weather upon trees is often marked. In many instances unfavorable weather brings about conditions which cause the death of trees or weaken them to such an extent that they are subject to infestation by injurious insects. A conspicuous instance is afforded by the severe drought of 1924 and 1925, which was general throughout the Southeastern and Southern States and seriously affected certain of the coniferous and hardwood trees growing there. Many trees died, and

the growth of others was severely checked. It is estimated that in the States of Mississippi, Louisiana, and Texas more than 500,000,000 feet of merchantable pine was killed as the result of a combination of causes, principally drought and bark beetles[1]. In North Carolina, also, the drought of 1925 was followed by similar damage[1], especially in the western portion of the State, where there was a deficiency of several inches of rainfall.

Craighead[2] has called attention to an apparent correlation between deficiency of rainfall and destructive abundance of the southern pine beetle, pointing out that all of the important outbreaks in the past have occurred in years when there was a deficiency of an inch or more of rainfall for the summer months. More recent studies conducted in the vicinity of Asheville, N. C., by the Bureau of Entomology have borne out these conclusions. Weather Bureau records for Asheville show that in the year 1925 there was a deficiency of precipitation from January to October, reaching its maximum in July and August, and that there was an accumulated deficiency of 18.4 inches for the year. During this period of deficiency pine and hardwood trees were observed to be dying. At that time an outbreak of the southern pine beetle occurred, and many species of hardwoods were affected and attacked by other insects. Figure 34 shows for the year 1925 the curves of normal and actual precipitation at Asheville, and in the center a shaded area, not concerned with the inches of precipitation, showing approximately the times of the beginning, maximum, and end of the period of flight of the hickory bark beetle. The time of heaviest flight coincides approximately with that of the highest normal precipitation, and with that of the maximum precipitation (and the most serious deficiency) for 1925. Hickory trees were conspicuous among those affected by the drought, many having an unhealthy appearance in the fall of 1925. Additional trees were weakened in 1926, and many of them died. Reports from widely separated parts of the State indicated that this condition was very general. An investigation of typical localities was made to determine whether drought alone was the most important factor in causing or hastening the death of the trees, or whether these losses were due to other agencies.

About the middle of July of that year groups of mockernut hickory trees, *Hicoria alba* (Linné) Britton, were examined at Swannanoa, N. C.,

[1]St. George, R. A., 1926. The recent death of large quantities of southern pine. American Lumberman, No. 2607, pp. 50–51.

[2]Craighead, F. C., 1925. Bark-beetle epidemics and rainfall deficiency. Jour. Econ. Ent., Vol. 18, 577–586.

to determine the cause of their unhealthy appearance. It was found that several of these trees had been heavily attacked by the hickory bark beetle, *Eccoptogaster quadrispinosus* Say. The trunk and limbs

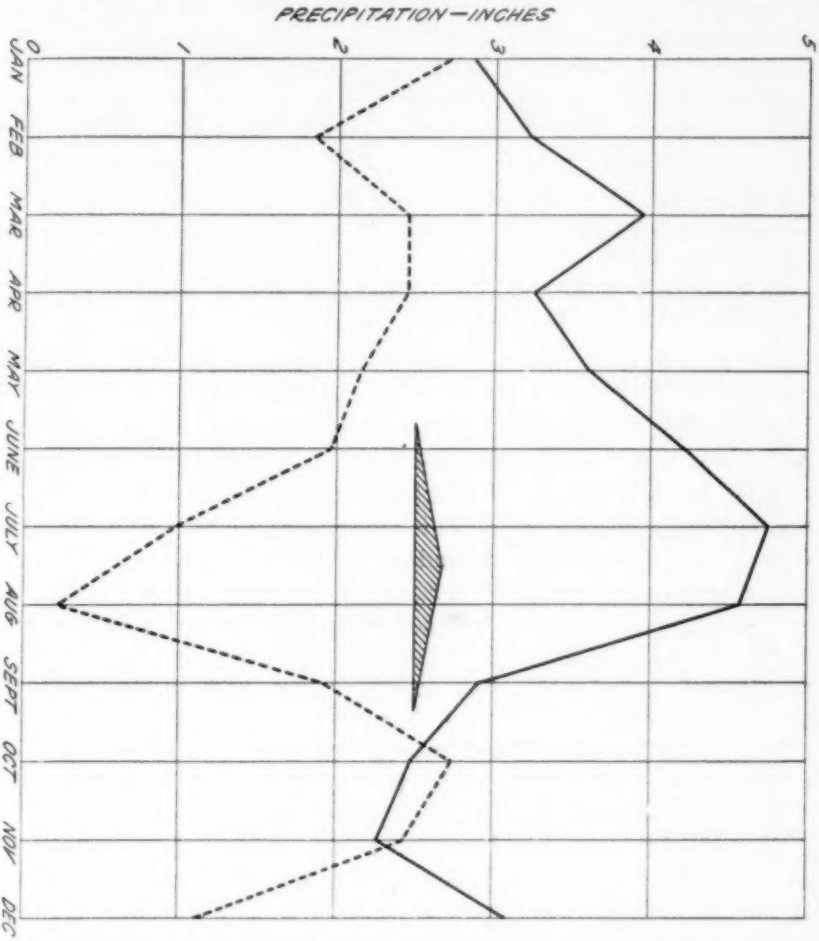


FIG. 34.—Curves of normal precipitation (solid line) and of the actual precipitation (broken line) for the year 1925 at Asheville, N. C. The shaded area in the center, not concerned with the scale of inches, shows approximately the times of beginning, maximum, and end of the flight of the hickory bark beetle.

of two of these infested trees, which had recently been felled, revealed the presence of healthy and heavy broods (immature stages) of this beetle. It was further found that this insect was the cause of the death and the dying condition of about 20 per cent of the hickory trees in the immediate vicinity.

According to information obtained locally the group of trees first attacked began to appear unhealthy late in the fall of 1925, when it was observed that some of the foliage was dying; the leaves turned brown and soon fell off, making the crown appear thin. This condition persisted through 1926, and all trees dying in that year were found to be infested by the hickory bark beetle.

On July 15, 1927, several of the dying trees were felled, and it was found that the broods of this beetle were in the larval, pupal, and mature stages, many adults already having emerged. Several adults were observed crawling along the trunks of the trees at that time. Wherever new attacks had been made eggs and tiny larvae were present. The beetles usually overwinter as larvae in the outer bark and emerge in the latter part of June and in July and August (Fig. 34). A few adults were found in flight at Greensboro, N. C., as late as September 9.

Effect of Drought and Insects on Tree Growth

An examination of the radial growth of all the trees which had been attacked at Swannanoa and neighboring trees which had escaped attack indicated that the drought had retarded their growth considerably, but in no case observed did it appear directly responsible for the death of a tree. The trees that had not been attacked survived, and all the trees that died contained bark beetles. It was noted that only a small quantity of wood had formed during the summer of 1925, when the severe drought occurred. A decided reduction in radial growth was likewise characteristic of the following year, 1926, in the trees that were infested only in part in 1925. The growth of trees attacked in 1926 was affected in a similar manner, being retarded in the first year (1926), and little or no growth being made in the second year (1927). However, no restriction of growth in 1926 was apparent in the case of trees which to the end of that year had escaped attack. Many of the trees that died were found to have made very slow growth during a period covering the previous ten years, as shown in Table 1. The trees not attacked grew more rapidly during this time. After the drought had ended they appeared to regain their normal vigor and growth, whereas the trees which had been attacked began to die.

Table 1 presents for a series of years, beginning with 1922, the annual radial growth of selected sample trees, cores for measurement of which were taken October 15, 1927. Of five trees that were infested in 1925 and 1926 and died in the fall of 1926, two show a steady decrease in width of the rings measured for 1922 to 1926, inclusive; one, and the

average of the five, a steady decrease from 1923 to 1926, inclusive, but not including 1922; and two, a steady decrease for the years 1924, 1925, and 1926. Of five, infested in 1927, and still living when the cores were taken in October of that year, the records are slightly less accordant, but one tree shows a diminution of annual growth during the six years for which measurements were made; two, and the average of the five, a reduction from 1923 onward, but not including 1922; the remaining two show a continuous reduction beginning with 1924. The measurements for these trees indicate a gradual reduction in rate of growth from 1923 onward, but indicate also that the trees of this group were more vigorous than those that died in 1926. Similar records for

TABLE 1.—MEASUREMENT OF RINGS SHOWING GROWTH OF INFESTED AND UNINFESTED HICKORY TREES (CORES TAKEN OCTOBER 15, 1927)

Core Number	Width of Ring Showing Growth for the Year— 1922	1923	1924	1925	1926	1927	Width of Last 10 Rings
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
TREES INFESTED IN 1925 AND 1926; DIED IN THE FALL OF 1926							
1	.35	.35	.40	.30	.25	—	3
2	.90	.85	.70	.60	.35	—	7
3	.85	.75	.50	.35	.25	—	7
4	1.20	3.25	1.65	.95	.90	—	16
5	1.15	1.60	1.95	1.60	1.05	—	17
Average	.89	1.36	1.04	.76	.56	—	10
TREES INFESTED IN 1927, AND ALIVE WHEN THE CORES WERE TAKEN							
6	.85	1.00	1.05	.85	.60	.45	9
7	1.10	1.75	1.70	1.00	.90	.70	12
8	1.70	1.80	1.90	1.35	.85	.60	14
9	1.65	2.10	1.60	1.35	.90	.85	16
10	2.10	1.95	1.80	1.35	.85	.80	17
Average	1.48	1.72	1.61	1.18	.82	.68	13.6
TREES WHICH HAD NOT BEEN INFESTED WHEN THE CORES WERE TAKEN							
11	1.00	1.15	.85	.60	.40	.60	8
12	1.65	1.80	1.50	.95	.75	.95	15
13	1.85	2.00	1.85	1.40	1.00	1.10	15
14	1.60	1.30	1.20	1.15	1.40	1.55	15
15	1.75	1.55	2.40	1.35	.95	1.80	17
16	2.25	1.80	4.20	1.80	3.75	3.15	30
Average	1.68	1.60	2.00	1.21	1.37	1.52	16.7

1922 to 1927, inclusive, are presented for six trees which had not become infested when the cores were taken from all the trees concerned in the table. The records for these trees, as well as their averages, show a common decrease in rate of growth only from 1924 to 1925, and, generally speaking, are rather discordant, but they indicate that the trees

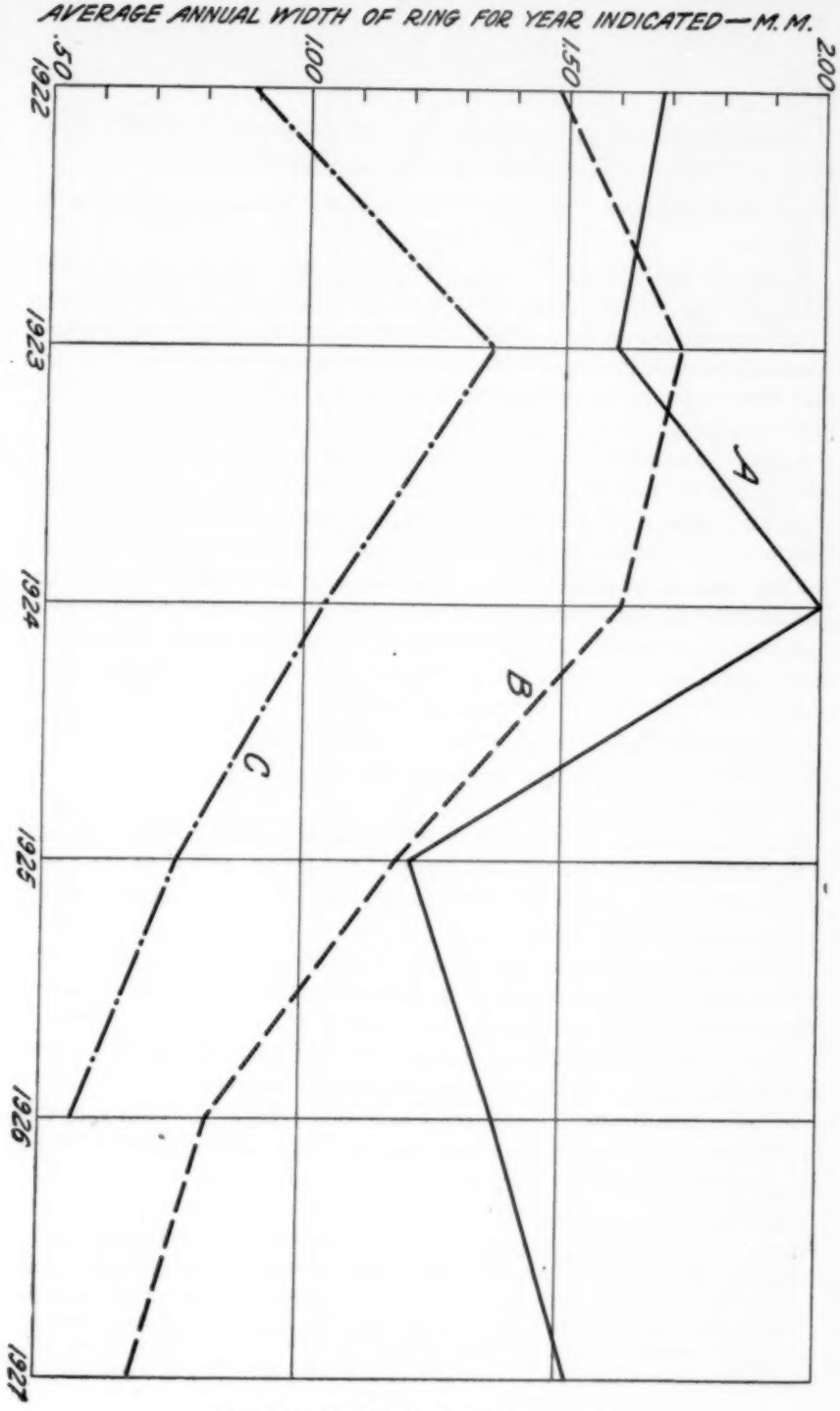
were more vigorous than those of the two preceding groups, again suggesting that trees of this type are more resistant to the attack of the hickory bark beetle than are less vigorous trees. They lead strongly to the conclusion that the trees that resist the attacks of insects are those that have not shown for several preceding years a more or less steady decrease in growth. The total width of the rings for the last 10 years' growth of each of the trees here considered was also measured; the average width per ring for the first group named was 10 mm., for the second 13.6 mm., and for the third 16.7 mm.; these figures point to the same conclusion as that just expressed.

Figure 35 presents graphically for the years 1922 to 1927, inclusive, the average width of ring of the trees of the three classes considered in Table 1. The solid curve A represents for those years the averages for the trees which had not been infested when the cores were taken for measurement but by their common decrease in growth from 1924 to 1925 had evidently been affected by the drought. The two broken curves represent the averages for the trees found to be infested, B, the one made by consecutive dashes, referring to those infested in 1927 and still alive when the cores were taken, and C, the curve of alternate dashes and dots, covering the years 1922 to 1926 for the trees infested in 1925 and 1926. Stated differently, the ring widths denoted in the figure are the averages recorded in Table 1.

Trees in the vicinity of Asheville, N. C., normally receive their maximum quantity of moisture during midsummer, but in 1925, the year of the drought, they received their minimum at this season (Fig. 34). This shortage of moisture undoubtedly contributed to the weakening of the trees, checking their growth, and making conditions more favorable for attack by insects. It also happens that in midsummer the bark beetles are present in greatest numbers, a fact that enables them to concentrate their attack on weakened trees, thereby more easily overcoming them. The condition of the trees in the vicinity of Asheville appeared to be more or less typical of those affected in other localities.

Blackman,[3] in a study of an earlier outbreak which occurred near Syracuse, N. Y., from 1912 to 1924, concluded that drought was an important factor in weakening hickory trees. thus making them attractive to the attacks of the hickory bark beetle; further, that it promoted the development of the broods of this beetle, and checked the growth of the trees. Measurements of the cores obtained at Swannanoa from

[3]Blackman, M. W., 1924. The effect of deficiency and excess in rainfall upon the hickory barkbeetle. Jour. Econ. Ent., vol. 17, pp. 460–470.



(FIG. 35.—See following page for legend)

hickory trees attacked by the beetle and from trees which escaped attack confirm Dr. Blackman's observations. (See Table 1).

Effects of Excess Precipitation on Development of Broods of the Bark Beetle

When the trees at Swannanoa were examined it was observed that many of the broods of the hickory bark beetle had died just after hatching. The tiny larvae had extended their mines only from one-fourth to one-half an inch in length. This mortality might be explained by the fact that heavy rains occurred just before the first beetles began to fly, and continued for a short time afterward. The excessive moisture under the bark was undoubtedly a factor in preventing development of the brood. Blackman's findings agree with this conclusion. He has shown[4] that an excess of rainfall acts as a distinct check on the activities of the beetles—"When the adults are active, continued rain kills many while feeding and establishing their burrows and also checks egg-laying. Excess rainfall, humidity, and cloudiness kill the larvae because they produce an excess of water in the plant tissues and this is set free into the larval mines."

Conclusions

1. A marked deficiency in rainfall weakens hickory trees and renders them attractive to the attacks of the hickory bark beetle, *Eccoptogaster quadrispinosus* Say.

2. The attack by this beetle is effective in checking radial growth, thus bringing about the gradual dying of the foliage and then the death of the tree. This appears to be especially true of slow-growing mature or over-mature trees of low vitality.

3. The deficiency in rainfall results not only in checking the growth of the trees but in producing conditions favorable for development of the brood of the hickory bark beetles.

4. An excess of rainfall during the period of flight checks the activities of the beetles and the development of the brood.

5. Such conditions of drought as were observed in the course of this investigation do not cause the death of trees which have not been attacked by the hickory bark beetle.

[4]See footnote 3.

Fig. 35.—Curves of radial yearly growth of hickory trees affected by drought. A, average widths of annual rings for 1922 to 1927, inclusive, of six trees not infested; B, average widths, for the same years, of rings of growth of five trees infested by the hickory bark beetle in 1927, but alive when the cores were taken for measurement; C, average widths, for 1922 to 1926, inclusive, of the rings of five trees infested by the hickory bark beetle in 1925 and 1926, and dying in the latter year.

SOME NOTES ON THE GRASSHOPPER SITUATION IN NORTH CENTRAL MONTANA

By ROBERT L. SHOTWELL, *Assistant Entomologist, U. S. Bureau of Entomology*

ABSTRACT

This discusses briefly the grasshopper situation up to and including the year 1926 in the part of Montana known as the Triangle. Observations were made of weather conditions surrounding a threatened local outbreak in 1926, the results of which indicate the intimate relationship between physical factors and grasshopper abundance and emphasize their importance in grasshopper control.

INTRODUCTION

For several years the farmers in North Central Montana have suffered varied losses from the ravages of grasshoppers, and especially from the lesser migratory grasshopper. This portion of the state embraces the following counties: Blaine, Hill, Liberty, Toole, Glacier, Pondera, Chouteau, and Cascade. They form a rough triangle with Canada on the north, the continental divide on the west, and the Highwood and Bear Paw Mountains on the south and east. Most of the land is non-irrigated and the major crop is hard spring wheat. The principal species of grasshoppers are the lesser migratory grasshopper, *Melanoplus atlanis* Riley, and the two-striped grasshopper, *M. bivittatus* Say, the latter being found in the irrigated sections. Of these, the lesser migratory grasshopper has caused by far the most damage.

PREVIOUS OUTBREAKS

There has been more or less trouble with grasshoppers in this portion of the state since 1917, but beginning with 1920 and continuing through 1924 the outbreaks have been especially wide-spread and destructive (Cooley, 1). During 1923 the outbreaks reached the peak of their widest extent and greatest damage. Practically every section of the Triangle suffered severe losses from the hordes of *M. atlanis*, and recalled the earlier ravages of the Rocky Mountain locust in 1875 and 1876. In the late summer of that year (1923) the general direction of the flights of the adults was westward from Blaine, Hill, Liberty, Chouteau, and Toole Counties into Pondera, Teton and Glacier Counties. According to forest rangers in Glacier National Park, small portions of this westward migration crossed the continental divide and reached a short distance down the west side. A good many landed in the Park on the east side. The effect of these westward migrations was seen in the outbreaks of 1924. During this year these outbreaks were localized and

spotted in all counties excepting Teton and Pondera, where the situation was just as serious as it had been the year before. Beginning with Blaine County on the east, where there was practically no damage in 1924, and working westward toward the Park, these localized outbreaks became greater in number and size as the Park was approached. Organized poisoned bran mash control campaigns on the part of the counties and state were necessary in order to cope with all these outbreaks, as the degree of infestation in each area was about the same as in 1923. Most of these campaigns were launched soon after the grasshoppers had hatched, and were vigorously carried out. Altogether they were successful in saving most of the crops.

In the fall of 1924 a survey of all these counties was made by the writer, and all the information possible was obtained concerning the grasshopper situation in each county. Small flights were reported in Pondera, Toole, and Glacier Counties, and all were toward the east. Some farmers in Toole County reported grasshoppers flying in from the west around the latter part of August. Evidently the general direction of all these flights during this year was opposite to the direction of the flights the year before. However, surveys showed no indications of eggs being deposited in great numbers in any part of the Triangle. What survivors there were of the control campaigns were found to be heavily parasitized by Sarcophagid flies. In May, 1925, this territory was again scouted but there were no indications of outbreaks in any part. In June a report came in of grasshoppers hatching down along the Masprias River in southeastern Liberty and southwestern Hill Counties in what is known as the Brinkman Country. However, there was no outbreak of importance and no damage was noted. The Masprias River is the largest river in the Triangle tributary to the Missouri and drains most of this portion of the state. It is along this river that the grasshoppers have been the most numerous each year, and this has given rise to the idea that this region is probably the principal breeding ground of the lesser migratory grasshopper in this part of the state.

Outbreak of 1926

Extent of Infestation. Late in the summer of 1925 reports began to come in to the County Agent of Hill County of large numbers of adults flying into the southwestern quarter of the county, presumably from the south and southwest in the direction of the Masprias River. Some damage was done by the cutting off of the heads of wheat, which was still in the milk stage. The only serious damage in the infested

area was the total loss of a 40-acre field of rye about three miles south of the town of Rudyard. However, the females deposited their eggs in large numbers over the whole territory. This territory, according to Mr. E. B. Duncan, County Agricultural Agent, Havre, Montana, involved approximately 15 townships (Duncan 2). The worst infestation extended from six to nine miles south of the Great Northern Railway, and from Gildford west to Rudyard. The territory south of the five towns Inverness, Rudyard, Hingham, Gildford, and Kremlin, to the Chouteau County line, had some infestation, but the heaviest infestation was south of Gildford and Hingham. There was also a small area about a mile wide and six miles long lying seven miles north of Hingham and Rudyard which had some infestation. Mr. Duncan scouted this whole territory twice during the fall of 1925, once while the grasshoppers were moving in and again after they had laid their eggs. In the worst infested places he found as many as 14 pods around the base of one wheat plant and an average of four to eight pods per square foot.

The writer visited this territory in October, 1925, and found as high as eight and ten egg pods around the base of single stools in all the fields examined. Many Bombyliid and Carabid larvae predaceous on grasshopper eggs were also observed. A small percentage of the eggs were parasitized by the Hymenopterous parasite *Scelio calopteni* Riley (det. Gahan). Around the straw stacks the eggs were the most numerous. The situation looked serious and several of the farmers in the vicinity were afraid to put in a crop the next spring. The seriousness of the situation was further emphasized early the following spring when men from the State Experiment Farm near Havre reported finding numerous egg pods in fields visited by them during the latter part of March and the first week of April, and that the eggs seemed to be in good condition.

Early Hatch and Disappearance of Nymphs soon after Hatching. In order to make use of this threatened outbreak in an effort to study various control methods under actual field conditions, the state and federal entomologists during the winter organized an experimental control campaign in cooperation with the County Agent. Everything possible was done to meet the situation when the grasshoppers would start to hatch. Ordinarily the nymphs of *M. atlanis* in this region do not commence hatching until about May 15, and the peak is not reached until the first week of June. In 1924 in this locality nymphs were first observed hatching about May 12, and the peak was reached about June 9. During the spring of 1926 reports of grasshoppers hatching in large

numbers began to come in from all parts of the infested district during the last week of April and first week of May, fully three weeks earlier than usual. Everything was immediately put in readiness to carry out the campaign. But the young nymphs soon disappeared from all parts of the infested territory and the threatened outbreak failed to materialize.

About two weeks after these reports of hatching had begun coming in, a thorough survey of the whole district was made by state and federal entomologists and these reports of early hatching were verified. Few or no grasshoppers were found in any of these places visited. Empty egg pods were found everywhere, but the hatched nymphs had disappeared. It was the same story everywhere. Farmers had noticed the young grasshoppers hatching in large numbers during the last week of April and the first week of May. From ten days to two weeks later the newly hatched nymphs had practically all disappeared. Evidences of some chewing on the young wheat was also noticed in several places, but no hoppers were found to account for this feeding. One man had planned on listing a nearby stubble field for corn about May 1. At this time his hired man reported grasshoppers hatching in great numbers in this field. The farmer immediately abandoned the idea of preparing this land and did not pay any further attention to it. About two weeks later the writer visited this same field and found numerous empty egg pods, but only a few nymphs. The reports of early hatching, the numerous empty egg pods, and the observing of third instar nymphs on May 16, fourth instar nymphs on May 24, and fifth instar nymphs on June 7, gave evidences of a general early hatch.

In order to remove any doubt as to the value of these reports and observations made by the farmers in this portion of the state on anything concerning grasshoppers, it can well be said that most of them have had from five to ten years' experience fighting this one pest, and have won their spurs in efficient control campaigns.

In the whole infested territory there were only three places left where the grasshoppers were thick enough to justify experimental work. The question then arose as to what caused the early hatch and the general disappearance soon after hatching. A careful study of the weather records of this section for this period and the actual field conditions might shed some light on the subject.

Eggs of *Melanoplus atlanis* gathered in this area during October, 1925, showed an advanced degree of embryological development at the time they were collected. The eyes, mouthparts, outlines of legs and anten-

nae, segments of the abdomen, etc., were plainly visible through the embryo sac after the chorion had been removed. Two weeks later some of these eggs were incubated at a constant temperature of 85 degrees Fahrenheit. They hatched within three days. At this time of the year, therefore, the eggs were ready to hatch within a short time when the temperature of the soil was maintained at an optimum hatching point. It was obvious that these eggs would hatch early in the spring should such a period of hatching temperatures occur.

Weather Conditions Relative to Foregoing Phenomenon. A study of the weather records for this region shows that such a warm period did occur at the time the reports of hatching began to come in. In order to obtain some figures pertaining to the relative amounts of hatching temperatures for the spring months of the four years, 1923 to 1926, inclusive, the daily maximum temperatures were plotted for these months. Then, by adding together the number of degrees the daily maximum air temperatures reached above 60 degrees Fahrenheit for ten-day periods during these months, comparative figures were obtained which indicated somewhat the relative hatching possibilities for each period. Sixty degrees Fahrenheit was used because it had been observed in the field that hatching ceased below this point. Also, in connection with temperatures, the total number of days showing precipitation for each period was recorded. These latter figures give some indication of the relative amounts of sunshine and cloudy days for each period. The resultant data are given in Table 1.

Table 1. Sum of Temperatures Above 60°F. and Number of Days Showing Precipitation in Inches for Ten-Day Periods from March 1, to July 1 for the Years 1923 to 1926

Month	Period	Sum of Temperatures and Days Showing Precipitation							
		1923		1924		1925		1926	
		Temp.	Precip.	Temp.	Precip.	Temp.	Precip.	Temp.	Precip.
	1–10	0	7	0	4	0	7	0	4
March	11–20	0	6	0	7	0	3	13	4
	21–31	5	2	0	7	20	3	10	6
	1–10	0	6	10	4	52	2	19	5
April	11–20	73	2	2	4	41	8	114	2
	21–30	41	5	21	2	24	4	118	1
	1–10	93	2	86	3	27	1	85	4
May	11–20	32	6	104	4	178	2	120	7
	21–31	194	5	82	5	146	5	148	4
	1–10	148	5	72	8	73	9	222	3
June	11–20	189	6	142	7	144	6	60	7
	21–30	137	6	119	5	257	2	236	4

A study of this table shows that the month of April, 1926, and especially from the elventh day on, was exceptionally warm and dry. These conditions offered much more of an opportunity for an early hatch during the spring of 1926 than did the conditions found in any of the other three years.

A more detailed study of the air and soil temperatures brings out the fact that such conditions were favorable for the eggs to hatch the latter part of April and the first of May, since there was a period of sunshiny weather from the twelfth of April to the sixth of May. The daily maximum air temperatures for this period ranged from 58° to 87° F., with ten days when the maximum was well above 70°. Only three days did the minimum go to freezing or below. The hourly soil temperature as recorded by a soil thermograph at egg depth, or one to two inches below surface of the soil, ranged above 70° for six to twenty hours per day, while the daily maximum soil temperature ranged from 74° to 91° during this whole period. The last week of April and the first week of May the soil temperature ranged above 70° from eleven to twenty hours per day, and averaged not more than four hours per day below 60°. It was during this time that reports of a general hatch began coming in, and there is no doubt that the exceptionally warm weather at this time brought about the early hatch. In order to account for the general disappearance of the nymphs soon after hatching, the weather records for this region were again consulted. They show that the warm period as previously described was immediately followed by a period of cold, cloudy, and windy weather. From May 5 to May 13, inclusive, the daily maximum air temperatures ranged from 50° to 71°. During these nine successive days there was only one day when the temperature was above 68°. The daily minimum air temperature for this period ranged from 33° to 46°. Strong winds prevailed every day, and of the nine days, six were cloudy. During this time the hourly soil temperature ranged from 47° to 90°, with from seven to fourteen hours per day when this temperature was below 60°. In other words, the soil temperature averaged ten hours per day below the point where hatching ceases, whereas this average for the previous two weeks when hatching was prevalent was only four hours per day. It is evident then that the period of warm weather which occurred around the last of April and the first of May was immediately followed by nine successive days when it was cold and disagreeable and unfavorable to the survival of the nymphs. After May 13, the weather became more normal.

Effect of Low Soil Temperature on Hatching. The significance of the low soil temperatures as recorded during this latter period can be

seen in the following two incidents which took place at this time. About 4 p.m., on May 11, the writer observed newly hatched nymphs in the soil still within the first sheath and inactive. The soil temperature was at once taken and proved to be 60° F. Furthermore these nymphs, when placed in the hand and warmed by body heat, immediately became active and cast this first skin, becoming regular first instar nymphs. The next day (May 12), in another field, this same phenomenon was again observed at about the same time in the afternoon. This time the soil temperature was 58°, and, as before, the nymphs became active when warmed by body heat. Evidently the process of hatching was held in suspension owing to the low soil temperatures. In the soil around the roots of the stubble in these two fields any number of masses of nymphs in this condition could be found at these particular times. The grasshoppers had hatched out of the egg cases, but owing to the low soil temperatures they could not work their way to the surface and free themselves of this first sheath. The infestation in these particular places was very heavy. It is a question how long these individuals could remain in this condition under such low soil temperatures without being seriously affected, if not destroyed. On the two particular days these observations were made, the soil temperature remained for ten and nine hours, respectively, below 60°.

About the middle of May a close search was made for the dead bodies of the nymphs from the empty egg pods Only a few were found in the cracks of the soil where they had gone to seek shelter from the cold and wind Considerable wind and soil was blowing at this time, which would easily take care of the remains of a first instar grasshopper

Effect of Sunlight on Soil Temperature and Hatching. In further field investigations during the latter half of May, 1926, unhatched eggs were found where the soil was protected by a covering of Russian thistles or straw around old straw stacks Temperatures of the soil were taken about 4:00 p.m., and those of the protected ground ranged from 62° to 68°, whereas those of the exposed ground ranged from 72° to 78°. This difference of about ten degrees occurred even within a few feet. Almost invariably the eggs in the unprotected soil had hatched out and the eggs in the shaded soil had remained unhatched. This explains why in a few places there were enough grasshoppers left to justify some experimental work, the lower temperatures in the protected places having prevented the early hatch which proved fatal to the major part of the infestation.

Conclusion

These observations point to the fact that the eggs of the lesser migratory grasshoppers in Hill County during the spring of 1926 were on the verge of hatching when the period of warm weather occurred around the latter part of April and first of May. This brought about an early general hatch. There followed then a period of cold and otherwise unfavorable weather conditions which apparently destroyed most of these newly hatched nymphs and nipped the threatened outbreak in the bud. Such things betoken the intimate relationship between physical factors and grasshopper abundance and emphasize their importance in grasshopper control.

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OBSERVATIONS ON THE BIRCH LEAF MINING SAWFLY

By H. B. Peirson, *Entomologist, Maine Forest Service*

Abstract

The following paper summarizes the facts known about a rather unusual type of forest insect pest, *Phyllotoma nemorata* Fallén, that threatens to destroy the white birch in New England. The insect is of foreign origin and has spread at an alarming rate, from Nova Scotia westward across New Brunswick and Maine into New Hampshire. Although the mining of the leaves occurs late in the summer, the injury practically stops the growth of the trees the following season.

During the late summer of 1927 extremely heavy infestations of a birch leaf miner (*Phyllotoma nemorata* Fallén) occurred in many sections of Maine. In areas where white birch was the predominating tree whole hillsides and valleys appeared as if fire had swept through the stands. The situation appeared so serious a study of the insect was started in June 1928. The work was carried on largely by K. A. Salman at a field laboratory maintained at Bar Harbor, Maine, by the Maine Forest Service. The following is a preliminary report of the results obtained to date.

The insect was first described in Europe in 1808. Subsequent writers describe its life history and habits as a pest of white birch in Scotland,

Netherlands, and Germany. About 1905 the leaf miner was first noticed in Nova Scotia and in 1909 was described by MacGillivray as a new species (*Phlebatrophia mathesoni*), at which time it had begun to assume epidemic form. The earliest record of its appearance in Maine seems to be in 1926. The distribution in Maine to date has followed largely the principal areas of white birch which occur in a belt approximately forty miles wide extending east and west across the central part of the State. The present outbreak has extended west into the White Mountain National Forest of New Hampshire, and specimens were also collected in South Hadley and Chesterfield, Massachusetts. In Maine there is but a single generation a year, whereas in parts of Europe there are two generations, the first occurring from June to August, the second from August to the following June.

The winter is spent as full grown larvae in round flat cells or hibernacula in the fallen leaves. These cells are waterproofed on the inside with a waxy secretion by the larvae. The cells average about seven millimeters in diameter and are quite tough. As many as five cells may be found in a single leaf. These are usually near the outer edge of the leaf, for the most part halfway between the tip and the base. The larvae pupate about the twenty-fifth of June. When pupating the larval skin is split, the pupa working out head first, but remaining in the hibernaculum. The pupa lies motionless in the cell, gradually growing gray, then darkening to black over parts which are black in the adult. The length of the pupal stage in one case was eight days.

The adult fly emerges in the vicinity of Bar Harbor from June 20th to July 10th with a few scattering adults found as late as July 20th. In Massachusetts the date of emergence may be a month earlier, whereas in the Rangeley Lake region of Maine, which is very high, emergence may occur a month later than at Bar Harbor. The greatest emergence occurs on warm, calm, sunshiny days.

The emergence of the adult from the pupal case takes place within the hibernaculum. The pupal skin splits and is worked off to the rear where the hind legs work it from the tip of the abdomen. The adult usually stays in the hibernaculum until color comes to the wings and the body becomes hardened. In emerging, the adult cuts a small circular hole with a lid to one side of the center of the surface of the hibernaculum, although in a few cases the lid was not present. The adult may emerge from either the top or bottom side of the leaves. Upon emerging the adult may feed to a small degree on substances such as honey dew.

No detailed study of flight habits have been made but it is evident from the rate of spread that the adults are capable of flying long distances. Temperature seems to be a dominant factor in their activities. On very hot days they seek the cooler and shaded sides of trees, whereas during cold or cloudy weather they remain inactive, usually on the under side of the leaves.

Soon after emerging the adult is ready to start egg laying. When about to oviposit the adult walks around with the antennae thrust out and downward feeling of the surface of the leaf, frequently placing the tip of the abdomen against the leaf surface. Upon finding a suitable place on the margin of the leaf the adult faces the petiole and inserts her saw almost invariably through the upper surface of the basal edge of a leaf tooth forming a pocket below the upper layer of columnar cells in the parenchymous tissue. It is in this pocket that the egg is laid. An adult lays approximately 25 eggs. Soon after being laid the leaf tissue surrounding the egg begins to darken and the place of oviposition can easily be seen. The egg apparently swells soon after being laid and its presence can be told by the appearance of a large bulge on the surface of the leaf above the egg pocket.

A study was made of the type of leaves chosen by the adults for oviposition and it was found that they almost invariably choose fully grown, well-formed perfect leaves. Seventy per cent of the eggs were laid in the leaves of the current year's growth and about 20 per cent in the perfect leaves on the old growth twigs. A few eggs were found in partly grown leaves of the new growth twigs, and a few in leaves mutilated or infested with other insects. Over 90 per cent of the eggs were found to be laid on the two-thirds of the leaf margin nearest the tip.

The average length of the egg stage based on a study of 66 eggs was 19 days. There is, however, a period of two days after hatching when it is difficult to determine from external examination whether the egg has hatched or not.

Just before hatching the eyes of the young larva can be seen through the shell as two dark spots. The anterior portion of the head capsule and mouth parts also assume a slightly brownish tinge. The embryo lies curled in the egg and apparently consumes all of the contents except enveloping skin of egg The larvae observed, hatched with the ventral side up and apparently eat the egg shell

The first feeding is hardly noticeable but after the first week the mining shows very plainly as brown patches In feeding the larva pushes its head forward and then draws it back rather than feeding from

side to side, making a blotch mine gradually widening the periphery in uneven ripples The mines are kept quite free of frass In most cases where two mines merge one of the larvae dies. In feeding the larvae shear through the veins. A study of 50 leaves showed that 70 per cent of the feeding is in the outer two-thirds of the leaf away from the petiole Feeding continues until September frosts, when the larvae form their flat circular cells in the leaf in which the winter is spent

The host plants recorded to date are White Birch (*Betula papyrifera*), Gray Birch (*Betula populifolia*), Yellow Birch (*Betula lutea*), Black Birch (*Betula lenta*), Alder (*Alnus* sps.) and Poplar (*Populus* sps.)

Systematic Position

Considerable difficulty was found in determining the exact taxonomic position of the insect, as it belongs to a genus not native to the American continent. In 1909 Doctor A. D. MacGillivray described it as a new genus and species, *Phlebatrophia mathesoni*, from specimens collected in Nova Scotia.

Specimens sent to Europe for comparison with *Phyllotoma nemorata* elicited responses not absolutely conclusive although the European specialists to which the material was sent all agree that the differences. if any exist, are very slight. Doctor Rohwer compared specimens collected in Nova Scotia, New Brunswick and Maine with European material and literature and has come to the conclusion that *Phlebatrophia mathesoni* MacG. is a synonym for *Phyllotoma nemorata* Fallén, and has so published his findings.

Description of Stages

Egg. The egg is regularly oval, about twice as long as wide. Average length about one-half millimeter. Surface smooth and moist. Color a watery grayish-white.

Larva. Buprestoid in form. Head dark colored. First three thoracic segments broad and flat, abdominal segments tapering towards the posterior extremity. The thoracic segments bear pairs of strong colorless legs. The second to ninth abdominal segments each bear pairs of weakly developed prolegs. The full grown larva is about seven millimeters long.

Pupa. Creamy-white to yellow changing to dark gray and black. Eyes black, wings short and bud-like, closely appressed to body as are the antennae and eyes.

Adult. Quite variable in size, body from three to five millimeters in length and from one to two millimeters in width. Body color in general jet black, wings hyaline somewhat iridescent, stigma on fore wings dark and very prominent. Only the females are known, there apparently being no males.

Head broad and narrow. Jet black except base of antennae and maxillary palpi which are yellow, mandibles brown, ocelli light brown, yellow band between eyes

and antennae, and between antennae. Antennae filiform, slightly pubescent, two mm. long.

Thorax. Two mm. long, jet black. Wings, five mm. long, two mm. wide. Stigma black. Base of coxae black, rest light yellow. Trochanter yellow, basal half of femur black, rest light yellow. Tibia light brown except for last segment and spurs which are brown to black.

Abdomen. Three and one-half mm. long, two and one-half mm. wide. Jet black except for outer anterior portions of segments which are yellowish white.

Nature of Injury

During the winter of 1928–29 a study was made in white birch operations throughout the State of the injury being done to the stands by the leaf miner. For this study detailed notes and measurement were taken on the average rate of growth of individual trees before and after the outbreak. These measurements were taken at the base of the trunk, halfway up the trunk, and just below the crown. These notes were summarized by plots with the amount of retardation. The plots were then summarized by forest type, rate of growth, exposure, density, and soil conditions. The result of the survey showed that there was a heavy retardation of growth throughout the infested region, in some sections amounting to 80 per cent. The heaviest retardation was found in the pure type, slow growing stands.

The fact that the heaviest injury comes at a time when the tree is storing up food for the coming season's growth makes the situation particularly serious. The results of the insects' work do not show up until the following season as growth depends largely on food stored up the previous season.

Control

The control work to date has been of a preliminary nature, but the results point to certain possibilities. Several heavily infested gray and white birch trees were sprayed the latter part of July with nicotine sulphate at the rate of 1 to 400 with the addition of one ounce (by weight) of dissolved laundry soap to each gallon of spray. At this time the larvae had just begun to mine so that small brown patches about one-half the size of the end of an ordinary lead pencil showed on the edges of the leaves. On the white birch 98 per cent of the larvae were killed; on the gray birch the spray proved 100 per cent efficient. Check trees showed a mortality of only two per cent. Observation showed that the spray takes effect very quickly. One and one-half minutes after leaves were treated three out of nine larvae were found to be dead and the remaining six were logy.

On June 22 a large series of trees were sprayed with Bordeaux at the rate of four ounces to a gallon of water, the object being to test its repellent possibilities. On some trees both upper and lower sides of the foliage were sprayed whereas on others only the top side. An analysis of over 3000 leaves from the sprayed trees and 2400 leaves from the check trees showed that there was a considerably lower percentage of oviposition on the sprayed trees but the infestation was not lowered enough to be of any real value. Bordeaux apparently toughens the leaves, but left numerous small brown dots over the surface of the leaf. Observations have shown that pubescence on the leaves may repel as does the toughness of the leaves.

Only a single parasite *Spilocryptus* sps. (possibly *albonotatus*) has been found. This was determined by Doctor Cushman of the U. S. National Museum.

Field studies have shown that pure slow growing types are most susceptible to injury so that these should be cut first.

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Scientific Notes.

Periodical Cicada Observations. Counts made of the Periodical Cicada, *Magicicada septendecim*, at several places, namely Alsen, Catskill, Athens, Leeds, Cairo, and W. Coxsackie, in Greene County, New York on forest trees, shrubs, apple, and pear trees in June and July 1928, showed the following relation between the large and cassinii form.

Large		Cassinii	
♂	♀	♂	♀
132	163	112	37
295		149	
66.4%		33.6%	

ALFRED S. MILLS

Notes on the Ovicidal Action of Linseed Oil. In experiments with ovicides against the Oriental Peach Moth and Codling Moth carried on in 1927 and duplicated in 1928 the following points were noted in connection with linseed oil, emulsified with sodium oleate:

(1) Susceptibility of the eggs varies with their age, the length of the incubation period, and the concentration of the oil in the emulsion.

(2) A large number of eggs develop to the "black-spot" stage and do not hatch.

(3) Raw linseed oil is more effective than boiled linseed oil. (Tests made against Oriental Peach Moth eggs only.)

(4) Emulsions of oil alone are more effective than emulsions of oil in which rosin has previously been dissolved. (Tests made against Oriental Peach Moth eggs only.)

J. WILLIAM LIPP, *U. S. Bureau of Entomology, Moorestown, New Jersey*

Plant Quarantine Inspection of the Dirigible "Graf Zeppelin." Publicity from many different points of view has been given the first foreign commercial passenger and cargo-carrying dirigible "Graf Zeppelin." From the standpoint of the possibility of plant pest introduction there are two avenues of danger; first, the possibility of dropping or dumping of plant produces or wastes when the vessel is travelling over land; and second, the actual landing on this soil with plants or plant products.

With regard to the first, if all future dirigibles are constructed and managed like this one, there would be no danger of dropping waste plant products while en route over land, as all windows, doors, etc., are kept locked while in transit in order to prevent possible damage to the craft by air currents. All wastes which left the vessel after landing at destination were burned.

As regards the second of these possibilities, however, while all fresh provisions such as fruits and vegetables had been consumed long before the arrival at Lakehurst, N. J., three bouquets of cut flowers—one of carnations, another of chrysanthemums and still another of roses, were seized in the passenger's quarters.

Interceptions made from this material were as follows:

INSECTS	PLANT DISEASES
Myzus persicae, Sulz.	*Heterosporium echinulatum*, Berk.
Tritogenaphis sonchi, Linn.	Sterile leaf spot, possibly *Septoria chrysanthemi*
Coccinae, possibly *Lecanium corni* (Bouche)	*Sphaceloma rosarum*.
Undetermined aphid	
Thrips tabaci, var. *pulla*	
Typhlocyba rosae, Linn.	
Eggs of sp. of Noctuidae	
Cocoon of Noctuidae	
Undetermined spider.	

MAX KISLIUK, JR., *Associate Plant Quarantine Inspector, Philadelphia, Pennsylvania.*

The Striped Peachworm (*Gelechia confusella* Chambers) on Cotoneaster. In October, 1928 *Gelechia confusella* Chambers was found breeding on the ornamental shrub, *Cotoneaster rotundifolia*, var. *lanata* Schneid., at Norfolk, Va. Pettit reported peach as the host in Michigan (Mich. Bul. 175. pp. 347–349. 1899.) and Ingerson (U. S. D. A. Dept. Ag. Bul. 399. pp. 1–16. 1918.) making observations also in Michigan found infestations on peach and sand cherry (*Prunus pumila*). Reared moths from cotoneaster were kindly identified by Mr. August Busck of the U. S. Bureau of Entomology.

The infested cotoneasters were small plants, and since this shrub has a recumbent habit of growth, some of the lower branches were just above or in contact with the earth. The attention of M. M. Parker of this Station was called to what appeared to be an accumulation of earth and debris on these lower branches. An examination showed that leaves and debris had been webbed together by red and white striped larvae. The tightly webbed nests, or rather tunnels in the case of cotoneaster, shelter the insects while they feed. (For descriptions and illustrations of the stages and injury, see Ingerson). The infested plants were removed, making it impossible to test control measures.

P. J. CHAPMAN, *Va. Truck Expt. Station*

An Outbreak of the Fig Moth in California. Previous to 1928, infestation of the California raisin crop (about 300,000 tons) developed almost entirely after rather prolonged storage. It had not been necessary to fumigate stocks of raisins sooner than the spring following harvest, and the chief pests were the Indian-meal moth (*Plodia interpunctella* Hübn.) and the saw-toothed grain beetle (*Oryzaephilus surinamensis* L.).

A new condition has arisen in the case of the 1928 crop. Raisins were observed to be infested when they were delivered to packing houses, and fumigation of new-crop raisins became necessary in the late fall and early winter. The insect principally concerned is the fig moth (*Ephestia cautella* Walker), accompanied by relatively small numbers of the Indian-meal moth, the migrating full grown larvae of both species being extensively attacked by *Habrobracon juglandis* Ashmead.

The present fig-moth outbreak in the San Joaquin Valley appears to have originated on ranches. Examinations of dried figs of the 1927 crop revealed the presence of a light infestation of ranch origin by this insect. Infestation became more general in dried figs of the 1928 crop, where, however, the Indian-meal moth was much more abundant.

The fig moth has been present in small numbers in dried-fruit packing plants in the Valley, at least since 1925, and, as noted above, was present on ranches in 1927. An unusually large hold-over on ranches of muscat raisins and cull figs from 1927 to 1928 was the most obvious of the factors which promoted the present outbreak.

PEREZ SIMMONS and W. D. REED, *Stored Product Insect Investigations, U. S. Bureau of Entomology, Fresno, California*

Insecticides Patent. During the year 1928 the United States Patent Office granted 536 patents on compositions of matter, processes, and apparatus of interest to entomologists, plant pathologists, bacteriologists, chemists, and others interested in the control of harmful insects, fungi, bacteria, weeds, rodents, and other pests.

About two-thirds of these 536 patents relate to apparatus and one-third to chemical compounds or mixtures. These 536 patents include patents for: 14 fumigants, 6 contact insecticides, 16 stomach insecticides, 13 fungicides, 3 herbicides, 69 bactericides and disinfectants, 10 wood preservatives, 24 food preservatives, 42 spraying and dusting machines, 22 fumigating devices, 66 fly screens and barriers, 17 insect traps, 49 mouse and other animal traps, 40 pasteurizers and sterilizers, 17 fruit washers, 20 weeders, 6 processes and devices for tree surgery, 5 apicultural devices, and 8 moothproof garment bags.

The Insecticide Division of the Bureau of Chemistry and Soils, U. S. Deaprtment of Agriculture, Washington, D. C., has issued during the past year in multigraphed form 12 "Reviews of United States Patents Relating to Pest Control," in which abstracts of the above-mentioned patents are given. This Review is sent gratis to anyone who requests that his name be placed on the mailing list.

R. C. ROARK, *U. S. Bureau of Chemistry and Soils, Washington, D. C.*

Injury to Sweet Potatoes in Storage by the Semitropical Armyworm. Early in November of 1928 throughout the coastal sections of the Carolinas it was observed that the semitropical armyworm, *Prodenia eridania* (Cramer), was defoliating sweet potatoes.

The infestation was unusually heavy in Pamlico County, N. C., and at the time the sweet-potato crop was harvested large numbers of the worms collected in the hampers in the field and were carried in this manner to the curing houses. When the potatoes were placed in storage the air temperature was cool, consequently the larvae were more or less inactive and escaped the notice of the growers. As the temperature was raised during the curing process the worms became very active and began feeding on the potatoes, tunnelling completely through some, eating away the ends or making unsightly holes in others, and in some cases consuming the entire potato with the exception of the outer covering. Larval castings were much in evidence, especially in the top layer of hampers, where most of the damage occurred. It appeared as if the majority of the worms crawled from the lower layers to the top layer of hampers before beginning to feed to any appreciable extent. The attack continued during the period of curing of the potatoes, or for about two weeks, after which the rooms in the storage houses were cooled to outside temperature.

When last observed on November 19, many larvae were still present in the curing house, but there were no signs of recent feeding. Nearly all larvae were inactive and appeared to be drying up without attempting to pupate. Dead specimens were to be seen in several of the rooms.

Only one curing house in the territory reported a serious injury from the attacks of this insect.

The damage to the sweet potatoes did not end with the cessation of larval feeding, for decay soon developed in the injured tubers, adding to the loss induced by the feeding of the larvae.

W. A. THOMAS, *Assistant Entomologist, U. S. Bureau of Entomology, Chadbourn, N. C.*

Notes on *Leptoglossus phyllopus* L. and L. *oppositus* Say. A severe outbreak of kernel spot in pecans which occurred in central Georgia in the year 1926 was largely attributable to the work of *Leptoglossus phyllopus* L., the southern leaf-footed plant bug. Observations on the feeding and breeding habits of this bug have since been made at Barnesville, Ga., to learn the relation of such habits to the activity on pecan nuts. Four favored hosts have been found: *Cirsium spinosissimum elliotti*, which is a red-flowered variety of the yellow thistle; *Yucca flaccida*, or weakleaf yucca; *Datura tatula*, purple jimson weed; and varieties of cowpeas. The insect has been recorded from all except jimson weed by numerous authors.

During 1928 the following records were made. The first overwintered adults were found May 26 congregated on blossoms of yucca which had begun to open four days previously. Nymphs were first discovered on that plant June 25 and the first adult matured on caged yucca July 20. On June 8, however, young were found on thistle and the earliest adult of the year matured on thistle June 30, so it is evident that overwintering adults were attracted to this plant earlier than to yucca. Beginning June 21 adults gathered on jimson plants at the Barnesville Laboratory. These plants had been blooming since June 9. On June 30 first-instar nymphs appeared on these same plants and some of them transformed to adults in cages on July 25. The fourth host, cowpea, was found to be infested by young and adults the last week in September. Probably bugs had fed on cowpea from the first of the month. In 1928 the last collection of active bugs, adults and nymphs, was made October 19 on jimson weed.

The four hosts are attacked in a regular succession which corresponds to the order of their flowering and fruiting. No bugs could be found on the new shoots of thistle (the first plant attacked) which arose after the flower stalk had died. Young were found on yucca pods July 7 and 13 but no adults came to yucca after June 30, by which time the blossoms had fallen. During late July and in August jimson weed appears to be the only host at Barnesville. Adults congregate on this plant in abundance to raise their young, which are usually found on the seed pods. Jimson weed fruited until frost which came two or three weeks after the bugs had ceased to be active. Cowpea was infested in the latter half of September and continued so until the vines were cut for hay. Adults were attracted also to a species of yucca that blooms in the fall and were taken September 15, 1928, and September 20 and November 15, 1927, on two cultivated plants of yucca in Barnesville.

Individual nymphs were collected on *Cassia* sp. September 13, 1927; on soybean September 24 and October 17, 1928; and on cocklebur September 24, 1928. No *Leptoglossus* were seen on pecan in Georgia during the two years 1927 and 1928.

Leptoglossus oppositus Say is much less common in the Barnesville region than is *phyllopus* L. At Musella, Ga., *oppositus* was taken in numbers on peach fruit in May, 1928. In September it was abundant on cowpeas at Barnesville.

The writer is indebted to Mr. W. L. McAtee of the U. S. Bureau of Biological Survey for determination of the species of *Leptoglossus* and to Dr. S. F. Blake of the U. S. Bureau of Plant Industry for identification of the plants *Cirsium* and *Yucca*.

THEO. L. BISSELL, *U. S. Bureau of Entomology, Experiment, Ga.*

***Ateloglossa cinerea* Coq., A Parasite of *Melanotus* sp.** Since parasites of Elaterid larvae are so rarely encountered, an instance of such an occurrence seems worthy of special mention. During June, 1919, six specimens of the Dexiid fly, *Ateloglossa cinerea* Coq. were reared by the writer from larvae of *Malenotus* sp. Three of the flies were reared from *Melanotus* larvae collected by D. J. Caffrey in his garden at Arlington Heights, Massachusetts, and two others were reared from *Melanotus* larvae collected by R. H. Van Zwaluwenburg at Arlington, Massachusetts. One other adult was reared the same season from a *Malenotus* larva supposedly sent in by C. N. Ainslie from Sioux City, Iowa, but there is a possibility that this larva was one from Arlington which in some way became mixed with the Sioux City lot. The occurrence of this species at Sioux City therefore needs confirmation. All six specimens were determined by Mr. C. T. Greene and are in the National Museum, the only other one there being the type specimen, which was taken by J. H. Lovell at Waldoboro, Maine.

Parasitism in the Arlington Heights material as a whole probably did not average over 3 per cent. One small lot of *Melanotus* larvae collected by Caffrey in the spring of 1921 from the same garden at Arlington Heights were found by Van Zwaluwenburg to be 20 per cent parasitized, apparently by *A. cinerea*, though there is no record of adults having been reared.

Only one parasite emerged from a single host larva, the maggot issuing through the side of the host and forming its puparium at or just below the surface of the soil. Mr. Caffrey states that in the field the parasitized *Melanotus* larvae appeared to have the habit of coming out on the surface of the soil about the time the parasite larvae were ready to emerge from them. After this habit was noted he found the parasitized larvae to be quite common on the surface of the ground.

C. M. PACKARD, *U. S. Bureau of Entomology*

An Unusual Occurrence of *Thrips nigropilosus* Uzel[1] on Cultivated Spearmint. In response to a request for investigation of an insect injuring cultivated spearmint, the writer visited the mint plantation of the A. M. Todd Company at Mentha, Michigan, about fourteen miles northwest of Kalamazoo, on July 17, 1928. It was found that this rather rare thrips was quite numerous on the plants in the adult and various nymphal stages, and that it was causing considerable injury to several varieties of spearmint over an area of at least several acres in extent. The lower leaves of many of the plants had been so badly injured that quite a few were falling off, and the whitened areas, resulting from the feeding, extended even to the leaves of the growing tops. Many of the lower leaves still remaining on the plants were almost entirely pale, with the black excrement of the insects showing in contrast. Any injury of this nature to the foliage, coming as this did, so close to the time of distilling, will quickly reduce the yield of oil per acre.

[1]Identified by Professor Glenn W. Herrick, Ithaca, New York.

On the next day the Todd Company dusted the infested plants with sulphur. This was followed during the week by two heavy, drenching rains. An examination of the plants on July 25, and two later examinations, a week apart, showed that the thrips were very difficult to find. They had disappeared as suddenly as they had appeared. The plants made a good recovery and no further trouble was experienced.

Hood reports this insect only from New York, Illinois, Iowa and South Dakota,[2] as occurring mostly in greennhouses. He also reports it as having been taken out of doors on mullein leaves (New York) and on wild lettuce (Iowa).

L. G. GENTNER, *Michigan Experiment Station, East Lansing, Michigan*

The Lethal Dose of Arsenic for the Newly-Hatched Codling Moth Larvae. From the early use of arsenical sprays in controlling the codling moth the belief has prevailed that the newly-hatched larva is killed by an extremely small amount of arsenic. This belief probably originated as a result of analyses made during the decade following 1880 to determine the amount of arsenic on sprayed apples. Certain of these analyses showed no arsenic on the fruit or in the calyx at the end of the season although supposedly good control of the worms had been obtained. In popular writings especially, the view has often been expressed that ideally the fruit should be covered by an invisible film of lead arsenate, and entomologists generally have been inclined to regard the strength of the lead arsenate spray as being relatively unimportant. This conception was considerably strengthened by a report of Lovett's in 1920 in which, as a result of laboratory studies with young tent caterpillars, the suggestion was made that perhaps the usual spray of two pounds of powdered lead arsenate to one hundred gallons of water was eight times stronger than required to kill the newly-hatched codling moth larva. My own investigations which favor increasing the strength of the spray according to the severity of the infestation and which picture newly-hatched larvae burrowing directly through coverings of lead arsenate, seem to be wholly contradictory to the idea heretofore prevailing.

In 1923 Haseman reported in this JOURNAL that 3.33 micrograms (0.00000333 g.) of powdered lead arsenate, which according to the formula $PbHAsO_4$ would contain 0.95 microgram of arsenious acid (As_2O_3), "may kill" small larvae of the codling moth. He did not work with newly-hatched larvae although he used some larvae that were "very small."

In Hilgardia in 1926 and in this JOURNAL last year I reported analyses showing the amount of As_2O_3 per square centimeter for different coverages and with different strengths of lead arsenate spray. Accepting ten micrograms per square centimeter as probably being about the maximum amount of As_2O_3 deposited by a spray of two pounds of powdered lead arsenate to one hundred gallons of water, it appears that if the newly-hatched larva swallowed the skin in entering the fruit it would obtain 0.096 microgram of As_2O_3. This calculation is based on the observation that the newly-hatched larva makes an entrance hole about 0.35 millimeter in diameter. However, as reported in the studies above mentioned, the larva swallows only occasionl bits while digging through the surface layer of skin. In one instance a larva was observed to cut out and cast side over sixty particles of the surface skin such as might bear spray residue, before clearing an area 0.35 millimeter in diameter, and in that operation three particles were apparently swallowed. Assuming the only arsenic swallowed was that which occurred on the three particles, the larva

[2]1927—Entomologica Americana, Vol. VII, (New Series), No. 4, p. 209–245.

obtained about 0.0048 microgram of As_2O_3. Since the amount of arsenic occurring on fruit in most sections of the country will probably average, not over five micrograms per square centimeter through the season, it might be concluded on the basis of the above assumptions that the larva obtains from 0.0024 to as much as 0.096 microgram of As_2O_3 in making its entrance.

These calculations are interesting but they should be considered largely speculative until more exact information on the way the newly-hatched larva obtains the poison, is secured. The studies reported in Hilgardia indicated that the entrance of a larva through a pronounced covering of lead arsenate is largely explained by the fact that the surface layer of skin is rejected. In addition to this factor I have observed several instances in which feces were ejected within a half hour from the time the larvae started entrance holes. This fact suggests that in some cases the first particles swallowed may pass rather quickly through the digestive tract and possibly only a small fraction of the arsenic is retained within the body. The experiments reported in Hilgardia also tended to show that under ordinary conditions of orchard control many larvae probably become poisoned more or less accidentally, as it were, by coming into contact with arsenic or swallowing arsenic other than that encountered when entering the fruit.

RALPH H. SMITH

Studies of Substitutes for Arsenate of Lead as a Soil Insecticide. During 1925 and 1926, experiments were conducted with larvae of the Japanese beetle (*Popillia japonica* Newm.), in which their response to soil poisoned with various chemicals was noted. The data obtained have not yet appeared in a technical journal, and, as the writer is no longer working on the control of larvae in soil, they are presented here.

In these experiments soil was poisoned at the rate of 1500 pounds per acre with each of the following chemicals: the fluosilicates of barium, calcium, and sodium, the fluorides of aluminum, barium, calcium, copper, lead, and zinc-ammonium, the borates of copper, lead, and mercury (ic), cobalt oxide, cobalt arsenite, the phosphates of barium, cobalt, lithium, and mercury (ic), mercuric and mercurous iodides, mercurous chloride, mercurous chromate, potassium chlorate, potassium perchlorate, potassium antimonate, and potassium cobaltinitrite (Fischer's salt). The larvae succumbed to the fluosilicates of sodium and barium, to mercuric borate and iodide, and to mercurous chloride.

The required amount of chemical (0.825 gram per 4-inch pot) was mixed with the proper amount of soil and the mixture potted. After five larvae had been placed in each pot (three pots per test), the pots were watered and placed on the greenhouse bench. At five-day intervals the pots were examined, the dead larvae were removed, and any living larvae were replaced in the poisoned soil. The examinations were discontinued after about one month and the mortality in the treated pots was compared with that in check pots.

Previous experiments had indicated that in the case of nearly all the grasses used for fine turf, only rough-stalked blue grass, annual blue grass and Canada blue grass did not grow normally in soil poisoned with lead arsenate at the rate of 1500 pounds per acre. Accordingly, seed of these grasses was planted in pots of soil poisoned at the same rate with sodium fluosilicate, with barium fluosilicate and with mercurous chloride. In all cases the grasses grew normally and were as vigorous as the grasses grown in unpoisoned soil.

Mercuric borate and mercuric iodide were not tested for their action on grasses, and mercurous chloride was used in only one field test, as the high price of these chemicals seemed to make their use impractical. Although mercurous chloride has been tested with fair success (Monteith, Jr., J. Observations on Brown Patch Control in 1927, U. S. Golf Association Green Section Bulletin 7:237–47, 1927) for the control of fungous diseases of turf grasses, the writer doubts if enough material is applied in these treatments to make it effective as a soil poison.

In outdoor tests the ground was first cleared of all grass, roots, stones, etc. The poison was then applied to the proper area in the form of a fine powder. The poison was worked in the soil to the required depth with a hoe. The surface was then smoothed over with a rake, and the seed planted. When sodium fluosilicate was used, plots which were exposed to sunlight throughout the day had a tendency to harden on the surface. This was possibly the result of chemical reaction with components of the soil, and subsequently baking by the sun. The hardening was sufficient in many cases to prevent the germination of the grass seed. (Leach, B. R. and J. W. Lipp. A Method of Grub-Proofing Turf. U. S. Golf Association Green Section Bulletin 6:34–39. 1926.).

When barium fluosilicate was used there was very little hardening of the surface of the soil. Soil poisoned with this chemical was toxic to the larvae, and had no deleterious effect on the grasses, including the three previously mentioned. Although this experiment was continued for two years, during which time larvae placed in the soil were readily killed, the length of the period during which the soil will retain its toxicity is uncertain.

J. WILLIAM LIPP, *Research Laboratories, U. S. Bureau of Entomology, Moorestown, N. J.*

A simple method of obtaining moth eggs: Quantities of grain stored on large plantations are often heavily infested with the Angoumois grain moth; the laboratory host of *Trichogramma*. Such an infestation is often available as a temporary source of host eggs. The following method for collecting the moths and obtaining egg-deposition was used by the writer while on a sugar plantation on the West Coast of Mexico.

Burlap sacks were used as traps. For satisfactory operation heavily infested corn either on the cob or shelled is required. The sacks are laid out loosely on the surface of the mass of grain and form attractive resting places for the moths which congregate in numbers on the ventral surfaces. Once or twice a day each sack is lifted clear of the grain and looped to form a funnel, the lower end encircling a cylindrical receptacle made of 20-mesh brass screen about 8 in. in diameter. Several sharp blows on the burlap precipitate the moths into the screen container. For most efficient operation enough moths should be collected in each container to completely cover the inside surface.

The container is then placed in a horizontal position within a housing so constructed that when a strong current of air is directed onto the container, the moth eggs will drop through the screen into a trough below and the moth scale-dust pass off through a vent. When collecting the eggs the container should be shaken or rotated to dislodge eggs adhering to the moths. Eggs adhering to the dead moths may be rinsed off under water pressure and dried.

STANLEY E. FLANDERS

The Control of the Tobacco Beetle in Upholstered Furniture. *Lasioderma serricorne* was identified as the cause of considerable anxiety to one of Knoxville's scrupulous house wives. Each morning numbers of worms were found on the floor. The larvae were coming through the cover beneath and had caused no apparent injury to the covers above. The davenport was turned over and a saturated solution of sodium fluosilicate was poured into the stuffing on the inside. The worms ceased to appear on the floor after this, and no further complaint was made. The simplicity of the method of control as compared with fumigation is obvious.

S. MARCOVITCH, *Tennessee Agricultural Experiment Station*

Sodium fluosilicate as a house fly poison During the past summer we were greatly annoyed by house flies, *Musca domestica*, coming into the laboratory from near-by dairy barns. With such an abundance of specimens at hand, several dishes containing a saturated sodium fluosilicate solution were placed near the windows. The flies appeared to drink readily from this solution as other sources of water were lacking. Within thirty minutes after imbibing the fluosilicate solution many of the flies succumbed. After two or three days a very pronounced reduction in the number of flies was noticeable.

Sodium fluosilicate is not volatile, and if the water is renewed a solution of the powder should last a very long time. Under favorable conditions where flies congregate near windows and little moisture is available, a sodium fluosilicate solution offers a very cheap and simple method for reducing the number of flies.

S. MARCOVITCH, *Tennessee Agricultural Experiment Station*

Successful Shipments of *Trichogramma minutum*. Successful shipments of the parasite, *Trichogramma minutum*, have recently been made by the writer and Mr. C. O. Hopkins of the Louisiana Experiment Station to Mr. R. W. E. Tucker, Entomologist of the Barbados Department of Agriculture. For the first consignment, parasitized eggs of the Angoumois grain moth were placed in a pre-cooled thermos container, and were sent by air mail to New York in time to be placed on the *S. S. Voltaire* February 2, 1929. These are reported to have arrived in good condition February 11. A second shipment went February 26 on the *S. S. Columbus*. Mass rearing and distribution of *Trichogramma* for control of *Diatraea saccharalis* and other pests will be tried in Barbados.

HERBERT SPENCER, *A. & M. College, Baton Rouge, La.*

The Eggplant Leaf-Miner, *Phthorimaea glochinella* Zeller in Tomatoes Shipped from Mexico.—Every spring the cities of St. Paul and Minneapolis receive numerous shipments of fresh tomatoes from points in Mexico. On May 10, 1929, Mr. R. M. Ferguson, Assistant Marketing Specialist, Bureau of Agricultural Economics, brought specimens of lepidopterous larvae to the Division of Entomology, University of Minnesota for identification. These larvae had been intercepted in a shipment of two carloads of fresh tomatoes originating in Mexico, and proved to be the eggplant leaf-miner, *Phthorimaea glochinella* Zeller. Approximately ten to fifteen per cent of the tomatoes in these two carloads were unmarketable on account of the injury by this insect. The fruit examined was injured in the way described by Morrill (JOURN. ECON. ENT., xviii, 712, 1925), "The worm enters the fruit at the stem-end—closes the

entrance to its tunnel by means of a silken web and seldom penetrates deeper than a quarter of an inch into the fruit." According to Morrill infested fruit is culled as far as practicable before shipping but in this case at least, the culling could not have been very efficient. While it is very unlikely that this insect could become established in Minnesota, it is conceivable that infested shipments of this sort might reach parts of the United States where the insect would become established and be injurious. Records of the insect in the United States include Virginia, Kentucky, Missouri, Louisiana, Texas, Colorado and California.

CLARENCE E. MICKEL, *University of Minnesota*

Hibernation of the Striped Cucumber Beetle In view of the fact that there is some doubt as to the hibernation quarters of the striped cucumber beetle, *Diabrotica vittata* Fab., the following observations made on this insect during the dormant season might be of interest.

On October 27, 1927, in a deciduous woodland near Chillicothe, Ohio, 27 living striped cucumber beetles were found under leaves in an area 5 feet square along with one dead specimen and the remains of several others.

A short distance from this location in the same woodland N. F. Howard, U. S. Bureau of Entomology, found 2 living beetles under leaves in an area 1 foot by 2 feet. On the edge of the woodland near a melon patch, the writer found one specimen.

May 1, 1928, in practically the same spot where the 27 beetles were found on October 27, 1927, 7 living beetles were found in a space 5 feet by 8 feet and 10 beetles in a space 4 feet by 5 feet.

The beetles were fairly active upon removal from the leaves.

The woods where these observations were made were fairly dense, consisting of beech, sugar maple, tulip, and other deciduous trees. It sloped from 10 to 15 degrees, faced toward the southwest, and was about 100 feet in elevation above the Scioto River. The location of the beetles in the woods was about 800 feet northwest of the remains of vines and melons in an old watermelon field.

During the summer of 1928, the nearest cucurbit patch was about one-quarter of a mile from the woodland where the beetles had been found in the previous fall and spring but search made on December 2, 1928, in this woodland resulted in finding 8 live beetles under the leaves in approximately the same location as where the beetles were found in the fall of 1927 and the spring of 1928.

The following observations of this insect in hibernation were taken from unpublished notes in U. S. Bureau of Entomology files and were made by the late H. O. Marsh in 1910 at Rocky Ford, Colorado. On March 10, 1910, Mr. Marsh states that he observed "a dozen or 20 beetles hibernating under leaves and berry canes. The beetles had a fine, bright color and crawled about actively when disturbed. None, however, were observed to make an effort to fly. A single, dead specimen was observed."

"March 31, 1910, plenty of bright, healthy beetles were observed under leaves, berry canes, and other rubbish in the same location as above.

"April 22, 1910, at this date several healthy adults were found hibernating under berry canes and leaves."

May 4, 1910, Mr. Marsh was unable to find any specimens in the above locality. Squash plants, some of which were putting out the third leaf, were growing along the edge of the berry patch in which the beetles hibernated, but were not infested.

O. E. GAHM, *Assistant Entomologist, U. S. Bureau of Entomology*

SECOND-NOTICE ON ERIKSSON PRIZES

The International Committee for Phytopathology and Economic Entomology beg to announce that two prizes are hereby offered for the two best Memoirs, giving an account of new and original work on the two following subjects respectively:—

(1) Investigations on Rust (Uredineae) Diseases of Cereals (Wheat, Oats, Barley and Rye).

(2) Investigations on the rôle played by insects or other invertebrates in the transmission or initiation of Virus Disease in Plants.

The value of each prize will be 1,000 Swedish crowns.

Competitors may be of any nationality.

Three typewritten copies of each Memoir must be submitted. They may be written in any one of the three languages, English, French or German.

Memoirs must reach the Secretary on or before May 1st, 1930.

The author's name must not appear on the Memoir itself, but each Memoir must be marked with a pseudonym or a motto and the full name and address of the author must accompany the Memoir, being enclosed in a sealed envelope bearing on its outside the same pseudonym or motto as is given on the Memoir.

The adjudication of the Rust prize will rest with a Jury, consisting of Professor Dr. Jacob Eriksson, Professor Dr. E. C. Stakman and Professor Et. Foëx.

The adjudication of the virus prize will rest with a Jury, consisting of Professor Dr. H. M. Quanjer, Dr. A. D. Imms and Dr. L. O. Kunkel.

The decisions of these Juries will be final, and will be announced at the Fifth International Botanical Congress, to be held in Cambridge (England) from August 16th to 30th, 1930. The copyright of the prize Memoirs will become the property of the Committee, who will endeavour to secure publication of them in a suitable existing periodical or, failing that, procure publication in some other way. Other Memoirs will be returned to their respective authors.

The Committee reserve the right to withhold the prizes should none of the Memoirs submitted be deemed of sufficient merit by the respective Juries.

Further particulars, if required, may be obtained on application to the Secretary.

For the International Committee for Phytopathology and Economic Entomology

T. A. C. SCHOEVERS, *Secretary*,
Nassauweg 28, Wageningen, Holland.

DOCTOR L. O. HOWARD HONORED BY THE UNIVERSITY OF CALIFORNIA

On Charter Day, March 23, 1929, the University of California expressed its appreciation of the valuable services rendered to mankind by Dr. L. O. Howard, by conferring upon him its highest scholastic honor, the LL.D. degree. At the close of the Charter Day exercises held in the Greek Theatre, Dr. Howard was presented to President W. W. Campbell by C. B. Lipman, Dean of the Graduate Division, who said:

"Mr. President, I present Leland Ossian Howard, for 16 years assistant entomologist, and for more than 33 additional years, chief of the Bureau of Entomology, United States Department of Agriculture; for 22 years the permanent secretary and guiding spirit of the American Association for the Advancement of Science." In conferring the degree, President Campbell said, "Leland Ossian Howard, energetic and able student of insects in their relations to the welfare of mankind, unsurpassed

benefactor of the farmers of the United States, and therefore, a perpetual creditor of all its countrymen; esteemed and beloved leader in the higher councils of American science: By authority of the Regents of the University of California I herewith confer upon you the degree, Doctor of Laws!"

This signal honor to a man beloved and respected by all his fellow workers was appropriately celebrated by the entomologists of California in the form of a reception-banquet tendered to Dr. Howard and his daughter at the Stephens Memorial Building, University of California, on the evening of Monday, March 25, 1929. W. B. Herms, Professor of Parasitology and Head of the Division of Entomology and Parasitology, University of California, acted as toastmaster and introduced as speakers Dr. E. D. Merrill, Dean of the College of Agriculture, University of California; Dr. C. A. Kofoid, Professor of Zoology and Chairman of the Department of Zoology, University of California; Dr. Barton W. Evermann, Director of the California Academy of Sciences; E. O. Essig, Professor of Entomology, University of California; and finally, Dr. L. O. Howard who gave a very splendid address on the development of the profession of entomology in the United States. There were 71 present, including the following:

Mr. and Mrs. S. L. Allman, Dr. and Mrs. F. E. Blaisdell, Prof. Lawrence Bruner and Miss Helen Bruner, E. W. Cannon, Dr. and Mrs. E. R. deOng, H. Durbrow, W. Ebeling, Prof. and Mrs. E. O. Essig and daughter, Mary Isabel, Dr. B. W. Evermann and Miss Evermann, A. J. Flebut, Dr. S. B. Freeborn, F. A. Haasis, G. S. Hensill, F. B. Herbert, Prof. and Mrs. W. B. Herms, Mr. and Mrs. W. W. Jones, F. P. Keen, Dr. and Mrs. J. F. Killeen, Dr. and Mrs. Harold Kirby, Dr. and Mrs. C. A. Kofoid, W. Lammerts, Mr. and Mrs. J. F. Lamiman, E. R. Leach, Mr. and Mrs. M. D. Leonard, Dr. S. F. Light, A. W. Lopez, Mr. and Mrs. O. H. Lovell, J. O. Martin, A. T. McClay, Dean and Mrs. E. D. Merrill, A. W. Morrill, Jr.t W. B. Parker, Mr. and Mrs. H. L. Person, Mr. and Mrs. Alvin Seale, L. M. Smith, Miss Harriet Smith, G. R. Struble, J. B. Steinweden, Miss Jocelyn Tyler, Rober, Usinger, Mr. and Mrs. E. P. Van Duzee, Dr. and Mrs. E. C. Van Dyke, G. H. Vansell, Mr. and Mrs. Grant Wallace, E. F. Wohletz, Prof. and Mrs. C. W. Woodworth, F. H. Wymore.—E. O. Essig.

The Gillette Club

In honor of the seventieth birthday of Dr. C. P. Gillette, Professor of Zoology and Entomology and Director of the Experiment Station of the Colorado Agricultural College, the Fort Collins members of the Gillette Club and their wives celebrated the occasion with a banquet and a special program on March 28, 1929 at the Armstrong Hotel, Fort Collins, Colorado.

The Club in looking forward to the time when a new Science Building will be erected at the College and named the Gillette Science Building, announced that it would have a large oil painting made of Dr. Gillette which is to be placed in his present Experiment Station Offices until the new building is a reality.

Dean S. Arthur Johnson of the College and a close friend and associate of Dr. Gillette made the presentation in a most fitting manner.

The Gillette Club with now nearly 80 members was organized Jan. 1, 1926 in connection with the 82nd. meeting of the A. A. A. S., in Kansas City, Mo. The membership consists of students and co-workers in entomology at the Colorado Agricultural College, either past or present, of Dr. Gillette. The purpose of the

organization is to foster a spirit of co-operation and fellowship among the members of this group. To Dr. A. A. Granovsky, now of the Department of Entomology of the University of Wisconsin, belongs the chief honor for the origin of the idea of the club.

The Club meets at the annual meetings of the A. A. A. S. The present officers are Chairman, F. C. Bishopp, Bureau of Entomology, U. S. D. A., Washington, D. C., and Sec.-Treas., Miss Palmer, Department of Entomology, Colorado Agricultural College, Fort Collins, Colorado.

W. P. YETTER, Jr., *Deputy State Entomologist Ft., Collins, Colorado.*

SIXTH ANNUAL ROCKY MOUNTAIN CONFERENCE

Notices have been sent out for the sixth annual meeting of the Rocky Mountain Conference of Entomologists, to be held in Pingree Park, Colorado, August 19 to 24, 1929. As this notice cannot be sent to all entomologists, we will be glad to have any readers of the JOURNAL get in touch with the Secretary of the conference if there is any possibility of their attending.

The headquarters of the meetings will be at the Colorado Agricultural College Forest Lodge and Bunk House in the park, at a distance of about 55 miles from Fort Collins. Accommodations are such that other members of the family can be taken care of and you are cordially invited to bring them along. The expense for accommodations and transportation to the park are prorated and have, in the past, been very reasonable.

We will appreciate having subjects for papers and discussions sent at an early date so that a tentative program can be arranged. In the past we have had from 11 to 16 states represented, so a varied program can be expected.

Insect collecting in this mountain area is usually very good at that season of the year.

If you are interested, notify the secretary as far in advance as possible.

GEORGE M LIST,

GEORGE M. LIST,
Secretary, Fort Collins, Colorado.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

JUNE, 1929

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication at $2.50 per page for all matter in excess of six printed pages, a part page counting as a full page, this limit not including acceptable illustrations. Photo-engravings may be obtained by authors at cost.

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ANNUAL SCIENTIFIC MEETINGS: 1929–30, Des Moines; 1930–31, Cleveland; 1931–32, probably New Orleans; 1932–33, Chicago; 1933–34, undecided; 1934–35, probably Rochester.

The Mediterranean fruit fly has been recently discovered in Florida, it occurring in seven counties at various points in an area approximately 50 miles North and South and 40 miles East and West. The Federal Plant Quarantine and Control Administration authorities and officials of the State Plant Board of Florida have agreed to prosecute a vigorous campaign of eradication, and whatever the outcome, this attempt should give valuable information as to the possibilities of actually eradicating an insect which has become somewhat well established. The Federal authorities have promulgated a state wide quarantine designed to prevent further spread and this has also been supplemented by drastic rules and regulations issued by the Florida State Plant Board. Inspection of all citrus groves and fruit plantings as well as most vegetables will be made and rather extensive and wide surveys are planned for the neighboring states of Georgia, Alabama, Mississippi and presumably other sections where there is danger of this insect having become established. Congress has authorized the use of $4,250,000 for this work, the funds being transferred from an earlier appropriation. The experience of the past 25 years in quarantine and control work makes it possible to bring to bear upon this problem a large amount of exceedingly valuable information not available in earlier days and the appearance of this insect upon American soil, though unwelcome and undesirable, affords an unusually good opportunity to test the possibilities of exterminative work.

Obituary

WARREN THOMPSON CLARKE

By E. O. Essig

Professor Warren Thompson Clarke, pioneer California entomologist, died at his home, 2317 LeConte Avenue, Berkeley, California, on Thursday, April 18, 1929, after several years of retirement from a life of arduous labor for the farmers of this state. He was born in San Francisco, March 15, 1863 and after finishing in the regular public schools, entered the College of Agriculture, University of California, in 1899 and graduated in 1903. During his student days he became interested in entomology and as an assistant to Professor C. W. Woodworth, and as field agent in Entomology, 1902–1905, he performed some very valuable investigations in both economic and systematic entomology. His first important paper was on the grape leafhopper, *Erythroneura comes* (Say)[1]. This was followed by a complete study of the potato tuber moth, *Phthorimaea operculella* Zeller, and its control,[2] the first valuable contribution on this insect published in America. His most important contribution to economic entomology was the life-history and control of the peach twig-borer, *Anarsia lineatella* Zeller,[3] in which he developed the use of lime-sulfur for the control of this most serious pest, a method which has been accepted and used throughout this country and many other parts of the world. In systematic entomology he was particularly interested in the homopterous family, Aphididae, on which he published several papers[4] during this early period. In the second of these he named the first species from California. Some of them have not been procured since and may have been introduced species which never became permanently established in the state.

After graduation he continued his field work with the Division of Entomology and became Assistant Entomologist and Field Agent, 1904–1906. At this time the hop aphis was a serious pest to the rapidly

[1]The California Vine-hopper, Calif. Agr. Exp. Sta., Rept. 1897–8, pp. 179–181 (1900).

[2]The potato-worm in California, *Ibid.*, Bul. 135, 30 pp., 10 figs. (1901).

[3]The peach-worm, *Ibid.*, Bul. 144, 44 pp., 19 figs. (1902).

[4]Conditions favoring wing development in *Nectarophora rosae* (Linn.), Calif. Jour. Technology, vol. 1, pp. 96–99 (1903).

A list of California Aphididae, Can. Entom., vol. 35, pp. 247–254 (1903). (A number of new species described.)

PROFESSOR W. T. CLARK, from a photograph taken in the extension booth of the College of Agriculture, University of California, at the National Corn Exposition, Dallas, Texas in February 1914.

growing hop industry in California and Clarke published a bulletin[5] on the life history and control of this insect. He also published the description of the cherry fruit sawfly, *Hoplocampa cookei*[6] (Clarke) which had just previously been discovered injuring cherries in Solano County by Matthew Cooke, for whom it was named. This was Clarke's last important work in the field of entomology, for in 1907 he was appointed Assistant Professor of Horticulture and Superintendent of Farmers' Institutes in the College of Agriculture, University of California, by Director E. J. Wickson and he devoted the remainder of his life to general agricultural extension work throughout the entire state of California. In 1911 he became Associate Professor of Horticulture and in 1913 Professor of Agricultural Extension, which position he held until he was retired as Emeritus Professor of Agricultural Extension, March 16, 1928. During this long period of service he published many articles as reports, bulletins and circulars of the Experiment Station and especially in the agricultural press. He never lost his interest in entomology and often attended the meetings of entomological organizations. One of his last papers dealt with the control of ants on shipboard in 1922.[7]

The three important species of aphis named by him are: the bamboo aphis, *Myzocallis arundicolens* (Clarke); Ceanothus aphis, *Aphis ceanothi* (Clarke) and the California willow aphis, *Macrosiphum californicum* (Clarke).

His work was of the first order and will remain as a testimonial of this fact.

Reviews

A Handbook of the Dragon Flies of North America by James G. NEEDHAM and HORTENSE BUTLER HAYWOOD, pages I–VIII, 1–378, numerous text figures. Charles C. Thomas, Publisher, Springfield, Ill., Baltimore, Md. 1929.

The authors state that this is a book for collectors of dragon flies and for students of natural history, and aim to provide a ready means of identifying species and recording observations. It is frankly a biological and systematic, descriptive work with keys for the identification of both adults and nymphs. The senior author's long studies in this group have placed him in an exceptional position to produce a text of this general nature.

[5]The hop aphis, Calif. Agr. Exp. Sta., Bul. 160, 13 pp., 7 figs. (1904).
[6]Description of a new species of sawfly, Can. Entom., vol. 38, pp. 351–352. (1906).
[7]Jour. Econ. Ent., vol. 15, pp. 329–333. (1922).

The dragon flies are a comparatively neglected group and we welcome this volume believing that it may be another means of promoting the study of somewhat common conspicuous insects which should be better known because of the importlant part they play in the control of the smaller aquatic insects in particular, especialy mosquitoes. This work, though primarily systematic and dealing with a group not recorded as economic, in reality is a marked contribution to economic entomology in its broader applications.

E. P. F.

Insect Nutrition and Metabolism. A Summary of the Literature by B. P. UVAROV, Transactions of the Entomological Society of London, December 31, 1928, pp. 255–343.

The British Committee on Civil Research in April, 1926, established a sub-committee on diatetics "to consider and report on the physiological and pathological conditions associated with certain rationed and specialized diets, with special reference to Kenya native tribes." This sub-committee also directed its attention to other nutritional problems and found, as all entomologists know, that there existed no general conspectus of the work done in the field of insect nutrition. Arrangements were made with the Imperial Bureau of Entomology whereby this summation of the literature has been made by Mr. Uvarov. It was published with the financial aid of the Empire Marketing Board.

It is of course impossible to summarize a summary. The author states in his introduction that "It would seem, therefore, that the problem of the nutrition and the metabolism of insects should be regarded as a key both to the successful control of injurious insects and to the progress of the industries dependent on the products of useful insects." This is a view of insect control not commonly held, but one toward which economic entomology must turn, if continued effective results are to be expected. This paper will be a boon to all those interested in the study of insect nutrition and metabolism; and for that reason it has seemed well to call special attention to it in this manner. It is also fitting that the hearty thanks of American workers be extended to their British co-workers for making this important help available to us.

E. F. PHILLIPS

Insects and Their Control by ANDREW WILSON, pages 1–342, 184 text illustrations. Thatcher & Anderson Company, New Brunswick, N. J., 1929.

This is a series of brief, popular accounts of the more important insects occurring upon garden plants, using this term in a rather broad sense. They are grouped under the various food plants, the latter arranged alphabetically. There are in addition a preliminary section on general information regarding insects and insecticides, one on household insects and a series of spraying schedules for the different fruits. There is an excellent series of illustrations reproduced from various earlier works.

The volume is evidently prepared to advertise the Wilson products, since they are recommended in all places where they can be used. The somewhat numerous errors evidence haste in preparation, though some may be charged to the proof reader. It is a source of regret that scientific names were not included, since in some cases

the reader may be in doubt as to the identity of the insect discussed. The reviewer has an impression that the work is an example of "ghost writing." Certainly one would not expect a chemist to have such an intimate knowledge of insects and their affairs.

The book is attractively gotten up and is evidently designed to be of service to gardeners and others with no special entomological training.

E. P. F.

The Problems of Applied Entomology by ROBERT A. WARDLE, pages I–XII, 1–587, 31 text illustrations. McGraw-Hill Book Company, Inc., N. Y. 1929.

This noteworthy volume is considered by its author as supplementary to the work entitled "Principles of Insect Control" by himself and the late Philip J. Buckle and with certain exceptions is limited to entomological work which has appeared since 1922. The scope of the book may be gleaned from the chapter titles as follows: Host Resistance, Climatic Resistance, Tropic Behaviour, Disease, Parasites and Predators, Theory of Insecticides, Stomach Poisons, Contact Insecticides, Fumigants and Combination Insecticides and Cultural Influence; these comprising Part I. The second part is devoted to area problems as follows: South-Eastern Asia, Mediterranean area, West Africa and Central America, Northwestern Europe, Euro-Asiatic Plains, North America, South America and Africa, Hawaii and Australasia, Locality Disinfection and Locality Protection. There are in addition to these a well selected bibliography, an index of authors and a subject index.

The volume is especially valuable because of the critical digest of recent literature in relation to the various special topics. The general student of Entomology will find in the discussion of area problems comprehensive accounts of entomological problems in all sections of the world. This phase of entomology has not, to the reviewer's knowledge, been satisfactorily covered in recent years, at least. This volume recognizes the essential unity of entomological problems throughout the world. It will do much to promote a comprehensive study of insects, a phase of increasing importance in connection with quarantines and large scale control measures.

E. P. F.

The Principles of Applied Zoology by ROBERT A. WARDLE, pages I–XII, 1–427, 54 text illustrations. Longmans, Green, and Co., London, New York, Toronto, 1929.

An Entomologist can hardly criticize a work on applied Zoology in which over one-third of the actual text matter is devoted to insects and insect activities. The discussions are grouped under three major heads, namely Medical and Veterinary Zoology, Agricultural and Horticultural Zoology and Animal Industries; insects and their relations to other life being discussed in each of the three parts. The matter relating to insects under Medical and Veterinary Zoology includes chapters on Toxic Inoculation, Entomiasis, Mechanical Transmission and Cyclical Transmission. Under Agricultural and Horticultural Zoology, there are chapters on soil organisms, two giving a brief, systematic, economic survey of the major insect groups, and others on the Life-Cycle, Distribution, Behaviour and Mortality Factors among insects. The third part contains a chapter on Bee-Keeping and one on Sericiculture and Lac Culture.

The author has brought a great many facts within a brief compass and to the reviewer the treatment appears too condensed to be clear in all cases, a condition

recognized by the author in the preface. It is our opinion that not all Entomologists will agree with the definition of parasite as interpreted by the author. We also take exception to the use of the word "Principles" in the title believing that the character of the work is better described by the word "Principals," though there is no doubt but that the writer has kept in mind throughout the volume the underlying principles obtaining in applied Zoology.

There is an extended classified bibliography and Entomologists and others interested in applied Zoology will find in this volume much that is helpful and a ready means of locating detailed information in relation to the numerous phases discussed.

E. P. F.

Principles of Forest Entomology by Prof. S. A. GRAHAM, pp. 339, illustrated. McGraw Hill Book Company, Inc., New York, N. Y. 1929.

The first text book on forest entomology strictly applicable to North American conditions has recently appeared. The author, Dr. S. A. Graham, is Associate Professor of Forest Entomology at the School of Forestry and Conservation, University of Michigan, and was formerly Instructor in Forest Entomology at the University of Minnesota.

The need for such a book has been recognized for a long time. It should serve as a guide and stimulus to the teaching of this subject, which is one of increasing importance to the forest schools in this country. The lack of an adequate text undoubtedly has been a great handicap to the wider presentation of the subject.

The subject matter is treated from a strictly ecological standpoint. The discussion of the individual species and the control or preventive measures are all developed around several biological principles. The introductory chapter discusses the economic importance of forest insects, particularly emphasizing the losses to green standing timber and to forest products. The principal sources of information on forest insects and the periodicals publishing forest-insect articles are cited.

Chapter 2 is devoted to an historical sketch of the development of forest entomology giving a very brief resume of the work which has been done in Europe and in America. Unfortunately the photographs used of several forest entomologists are poor or were poorly reproduced. The work of Dr. A. D. Hopkins, who has undoubtedly done more to put forest entomology on a firm foundation in this country than any other single individual, is too briefly mentioned.

Chapters 3, 4 and 5 are chiefly ecological. The author has presented recent biological theories and shown their application to forest entomology in a very interesting way. This is the first time that all this matter has been brought together in a uniform and correlated manner. Practically all the principles which are developed are well illustrated by examples of insects of importance in forest entomology.

Chapters 6, 7, and 8 discuss insect control. The usual methods applied against forest and shade-tree insects are classified under such headings as direct and indirect control and further subdivided as mechanical, chemical, biotic, and control through the modification of the insect's environment or food supply. The biotic method of control is further amplified to show how parasites and silvicultural practice within the forest can be utilized in reducing the abundance of insects. The suggested cost of airplane dusting (page 86) is extremely low. It is doubtful if dusting can be done on a commercial scale at $3 to $6 per acre over forests. Frequently the cost of poison alone amounts to more than the lower of these figures.

On page 94 two important stickers for spraying materials (fish oil and linseed oil) are not mentioned. These are cheap, satisfactory, and widely used at the present time for large-scale spraying operations.

In discussing barking as a method of control (page 104) no mention is made of the serious results which frequently come from checking of barked logs which under most conditions make this method totally impractical.

In the discussion of control through the use of introduced parasites considerable stress is put on the competition between parasites as an important factor to be considered. There is no question but that such competition sometimes reduces the effectiveness of the parasites but, on the other hand, if this fact were allowed to influence us unduly in our attempts to introduce and colonize new parasites little would ever be accomplished. It would take an enormous amount of time and effort to study each of these parasites in its native home in sufficient detail to form some idea of their influence upon one another, and then it would be entirely impossible to determine whether that same relation would hold when they were introduced into an entirely new environment.

Beginning with Chapter 10 various types of forest insects are considered and illustrated by detailed discussion of certain species. The types of insects, or subdivisions of forest insects based on type of injury, are quite logical and are commonly accepted. These subdivisions are as follows: Leaf-eating insects, meristem insects of the terminal parts, meristem insects of the cambium region, cambium-wood insects, wood destroyers (chiefly insects affecting forest products), sap-sucking insects (true bugs and scale insects), insectivorous parasites, and insectivorous predators. The specific illustrations selected for many of these types are largely taken from the species occurring in the northeastern part of the United States. It is felt that the book would have a little wider application or be more acceptable to workers in the West if more examples from those regions had been taken, though it must be admitted that there has been less published on these insects which would serve as a source for compilation. At the present time the economic side of forest entomology is receiving much more recognition in the western part of the United States.

As stated before, the presentation of the subject matter is very cleverly centered around an ecological conception of the whole problem of forest entomology. In carrying this theme to a logical conclusion, it appears to the reviewer that certain statements are somewhat overdrawn or of only local application. For example, on page 117, under the heading "The Use of Competition," the controlling effect of logging operations on bark beetles is explained by the increase of secondary wood borers. This factor is no doubt of some importance, yet those who have studied this problem in some detail find that the decrease in the beetle population can be explained more simply by the altered moisture and temperature conditions in the felled logs. The treatment of the two-lined chestnut borer (*Agrilus bilineatus*) gives the impression that it is a primary pest in oak. This may be the case locally, but, considered throughout the range of this insect, it has been our experience that it attacks only extremely weakened or dying trees. Furthermore, if we accept the author's definition of primary insect on page 169, this beetle could hardly be considered primary.

On the whole, this first attempt to prepare a general text on forest entomology from a stricty North American viewpoint is to be commended. It is extremely well written—in a very pleasant and readable style. It should be well received not only by entomologists but by foresters as well.

F. C. CRAIGHEAD

Current Notes

Dr. L. O. Howard visited the field laboratory at Alhambra, Calif., on March 12 to 14.

George W. Still, Bureau of Entomology, has accepted a transfer from Arlington, Mass., to Sandusky, Ohio.

Mr. Glendenning, Entomological Branch, has been promoted from Junior Entomologist to Assistant Entomologist, dating from April 1.

Mr. F. C. Gilliatt, Entomological Branch, has been promoted from Junior Entomologist to Assistant Entomologist, dating from April 1.

P. D. Sanders, of the Department of Entomology of the University of Maryland, visited the Gipsy-Moth Laboratory on February 6.

On March 1, W. H. Rumff was appointed field assistant, Bureau of Entomology, at the cooperative field laboratory at Florence, S. C.

On March 15, S. L. Calhoun was appointed field assistant, Bureau of Entomology, in pink boll-worm investigations at El Paso, Tex.

Gilbert T. Bottger and John L. Breitwieser have been appointed Junior Entomologists, Bureau of Entomology, for duty at Monroe, Mich., and Arlington, Mass., respectively.

On March 9, Mr. Gibson Dominion Entomologist, lectured before the Royal Canadian Institute, Toronto, on the subject, "The Insect Peril—What it Signifies."

Mr. N. Criddle, Entomological Branch, who has been in Ottawa during the greater part of the winter, returned to Treesbank on March 9.

Roy E. Campbell, Bureau of Entomology, of the field laboratory at Alhambra, Calif., visited the field laboratory at Tempe, Ariz., on March 26.

A. B. Baird, in charge of parasite work in Canada, visited the Bureau of Entomology field laboratory at Arlington, Mass., on March 14 and 15.

A. G. Weeks, of Boston, a well-known student of Lepidoptera called at the National Museum March 6 to consult with Dr. William Schaus.

C. S. Ruse was appointed Assistant Entomologist, Bureau of Entomology, March 1, and has been assigned to the pink boll-worm field laboratory at El Paso, Tex.

Prof. Herbert Osborn was in Washington, D. C., April 20 to 24 attending Entomological board meetings and conferences in relation to several entomological projects.

On March 20, Perez Simmons and W. D. Reed, Bureau of Entomology attended a meeting, held in Fresno, of the State Fig Clean-up Committee.

M. D. Leonard of the Tobacco By-Products and Chemical Co., was a visitor at the Bureau of Entomology field laboratory at Alhambra, Calif., on March 19.

N. F. Howard, Bureau of Entomology, Columbus, Ohio, spent March 18 and 19 in Washington, discussing certain phases of the situation regarding the Mexican bean beetle.

Dr. W. A. Hoffman, of the Medical School in Porto Rico, visited the National Museum on March 16 to examine types of some minute blood-sucking midges.

On March 10, Dr. George L. Baker, Assistant Research Chemist at the Delaware Agricultural Experiment Station, visited the Japanese Beetle laboratory to consult with chemists there.

N. F. Howard, and R. Cecil, Bureau of Entomology, Columbus, Ohio, attended the meetings of the North Central States Entomologists at East Lansing, Mich., February 28 and March 1 and 2.

Miss Alma W. Rutledge, a graduate of the University of Illinois, accepted a temporary appointment, effective March 5, as Junior Scientific Aid in the Taxonomic Unit, Bureau of Entomology.

D. E. Fox, Bureau of Entomology, has been transferred from Twin Falls, Idaho, to Richfield, Utah, where he will assist E. W. Davis in investigations on the sugar-beet leafhopper.

T. P. Cassidy, Bureau of Entomology, in charge of the field laboratory at Tucson, Ariz., arrived at Tallulah on March 30, for a few days conference with B. R. Coad.

Mr. Hisashi Nishikawa, of the Agricultural Experimental Station, The Government-General of Chose, Suigen, Chosen, Japan, visited the Bureau of Entomology March 20. Mr. Nishikawa is interested in sericulture.

J. C. Elmore, Bureau of Entomology, returned to Garden Grove, Calif., March 31, from his visit to Washington. He also stopped off at the field laboratory at Twin Falls, Idaho.

F. F. Carpenter of the Roosevelt High School, Dayton, Ohio, recently visited the National Museum to examine material in some species of flies the larvae of which attack water lilies.

Mr. Carl Schedl, Entomological Branch, has completed a report on biological studies of the hemlock looper and is now carrying on systematic and morphological studies of bark beetles (Pityophthorinae).

On March 26, Dr. R. W. Glaser and N. H. Coria, both of the Rockefeller Institute, Princeton, N. J., visited the Japanese Beetle laboratory to consult with L. B. Smith and Dr. Henry Fox.

V. I. Safro, Bureau of Entomology, Director of Japanese Beetle Suppression for the New Jersey Department of Agriculture, has resigned his position to enter commercial work with the Kay Laboratories, West Nyack, N. Y.

L. C. McAlister, Bureau of Entomology, was transferred early in March from Moorestown, N. J., to Cherryfield, Me., where he will be associated with Dr. F. H. Lathrop in investigations of the blueberry maggot.

On March 25, William H. Thorpe, Demonstrator, Zoological Laboratories, Cambridge, England, visited the Japanese Beetle laboratory to observe the equipment for biological control. Mr. Thorpe was also interested in the chemotropic work.

E. Avery Richmond, formerly in charge of physiological work at the Japanese Beetle laboratory, has tendered his resignation, effective April 1. Mr. Richmond has taken a commercial position with Rohm and Haas Co., Bristol, Pa.

R. E. Campbell, Bureau of Entomology, made a trip to Arizona during the latter part of March, visiting the field laboratory at Tempe and consulting with Dr. E. D. Ball at the University of Arizona.

Probationary appointments as Junior Entomologists, Bureau of Entomology, have been given D. E. Fox, assigned to duty at Twin Falls Idaho, effective February 1, and C. W. Getzendaner, assigned at Puyallup, Washington., effective February 16.

Mr. L. S. McLaine, Entomological Branch, visited the Montreal plant inspection port, on March 26 and 27, and took up various matters pertaining to the port work with the inspector in charge and officials of transportation companies.

Perez Simmons and W. D. Reed, Bureau of Entomology, attended the 21st annual meeting of the Dried Fruit Association of California, held January 10 to 12, at Del Monte, Calif. Mr. Simmons read a paper entitled "Pest Control News."

From April 1 to June 15, Dr. T. E. Snyder will be on leave without pay to give a course in biological entomology at the University of Chicago, and expects to return to Washington about the middle of June.

On March 19, H. S. McConnell, of the Maryland Agricultural Experiment Station, at College Park, called at the National Museum to obtain from the bureau's specialists in taxonomy information on some parasitic Hymenoptera in which he is interested.

R. T. Webber, Bureau of Entomology, Melrose Highlands, went to Washington on March 24, to be there for about 10 days. He will spend considerable time at the National Museum, studying material belonging to the tachinid genus Achaetoneura.

R. J. Sim, Bureau of Entomology, visited the New York State Museum at Albany on February 18 and 19, and the American Museum of Natural History in New York City on February 20, 21 and 22, to study types of Phyllophaga.

Mr. E. McMillan, Entomological Branch, addressed a conference of Saskatchewan Weed Inspectors, at Regina, on Feb. 18, and while there conferred with provincial officers, particularly in regard to improvement in the reporting and location of cutworm and grasshopper outbreaks.

Morgan Hebard, of the Philadelphia Academy of Sciences, spent March 25 with A. N. Caudell at the National Museum, studying the National collections of Orthoptera, with special reference to a paper which he is preparing on the Orthoptera of Colorado.

Appearing on the Program of the Central California Citrus School, held at Portersville, Calif., E. A. McGregor, Bureau of Entomology spoke February 8th on the subject "The Latest Word in Citrus Thrips Control." About 200 growers attended this meeting.

The annual meeting of the British Columbia Entomological Society was held at Vancouver, on Feb. 23. In addition to Mr. Downes, the following Branch officers attended and presented papers: Messrs. E. R. Bucknell; R. Glendenning; Eric Hearle and A. A. Dennys.

Breeding of the corn borer parasite, *Exeristes roborator*, was discontinued at Chatham, Ontario, laboratory on March 30, after a total of nearly 60,000 spin-ups had been secured. No further work with this species will be carried on until summer.

H. G. Butler, a graduate of the Colorado Agricultural College, was appointed Assistant Entomologist, Bureau of Entomology, March 14 and assigned to duty at Wichita, Kans., where he will be associated with Dr. P. M. Gilmer in investigations of the codling moth.

A periodical exchange was started about January 1 at the Gipsy Moth laboratory, different members of the staff subscribing to one or more periodicals which, for the most part, deal with entomology. At present 22 periodicals are made available in this way.

Mr. W. Downes, Entomological Branch, Victoria B. C., has commenced an investigation into the cause of injury to young raspberry fruit in cooperation with Dr. W. Newton of the Sidney Experiment Station. Studies of thrips suspected of causing the injury are being made in this connection.

The Ohio Legislature at their recent session appropriated $150,000 for two new four story wings to be added to the present Botany and Zoology Building at Ohio State University. This will furnish considerable room for the expansion of the graduate work in entomology.

J. R. Douglass, Bureau of Entomology, in charge of the field laboratory at Estancia, N. M., is visiting the Mexican bean beetle laboratory at Columbus, Ohio, to check results of work on the Mexican bean beetle at Estancia and to make arrangements for future work.

R. W. Harned, State Entomologist of Mississippi, visited the Bureau of Entomology field laboratory at Biloxi, Miss., on March 2, and discussed certain phases of the work on the sweet potato weevil being conducted jointly by the Bureau of Entomology and the Mississippi State Plant Board.

T. L. Bissell, Bureau of Entomology, until recently of the pecan-insect field laboratory at Barnesville, Ga., which has been discontinued, is now in immediate charge of pecan-insect investigations at Experiment, Ga., where laboratory facilities have been provided by the Georgia Agricultural Experiment Station.

Mr. L. J. Simpson, Entomological Branch, visited Ottawa, from Fredericton, N. B., on March 5, to discuss plans with Dr. Swaine, regarding the coming season's work, and left Ottawa, for Fredericton, on March 12. During 1929, he will be engaged principally in continuation studies on the biology of bark beetles.

C. W. Collins, Bureau of Entomology, of the Gipsy-Moth Laboratory, was in Washington, February 18 to 21 to confer with Dr. Craighead, and with Doctors Marlatt and Quaintance and Mr. Graf, regarding the work of the laboratory. After leaving Washington he made a short visit to the Japanese Beetle Laboratory.

R. T. Webber, of the Gipsy Moth Laboratory, Melrose Highlands, Mass., went to the National Museum on March 25 to spend a few days examining types and other material in order to complete a paper on a group of parasitic flies which he has been studying for several years.

Dr. L. O. Howard visited the Bureau of Entomology New Orleans laboratory on March 9. He was especially interested in three species of parasities sent from Argentina by H. A. Jaynes, who is collecting parasites in South American countries for trial against the sugar cane moth borer in the United States.

W. H. White, Washington, D. C., and N. F. Howard, Columbus, Ohio both of the Bureau of Entomology, visited Norfolk, Va., February 5, where the cooperative work on the Mexican bean beetle for the coming season was discussed with the workers of the Virginia Truck Experiment Station. Dr. Howard returned to Columbus February 8.

Dr. E. D. Ball, Director of the Experiment Station and Dean of the College of Agriculture at Tuscon, Arizona, spent the week of April 20th in Washington and stopped at Ohio State University on April 27th on his return trip to consult with Prof. Herbert Osborn, D. M. DeLong and J. P. Sleesman.

Dr. L. O. Howard, former chief of the Bureau of Entomology, gave two lectures at the University of Wisconsin on April 14 and 15. One of these on Economic Entomology, was given to the members of the Department of Entomology. A second lecture on Medical Entomology was delivered before a general University group.

On February 21, Dr. Back, Bureau of Entomology, gave an informal talk on control of fabric pests at the National Institute of Cleaners and Dyers, at Silver Spring, Md. Men attend this institute from all parts of the country, many being sent at the expense of the firms by which they are employed.

On February 19, at Spokane, Wash., E. J. Newcomer, Bureau of Entomology, in charge of the field laboratory at Yakima, Wash., for investigations of the codling moth, met with representatives of the Washington Experiment Station and the Washington State Department of Agriculture to formulate recommendations for State Control of the codling moth in 1929.

K. L. Cockerham, Bureau of Entomology, Biloxi, Miss., attended the meetings of the Cotton States Entomologists Branch of the American Association of Economic Entomologists, at Houston, Tex., February 6 and 7. Afterwards, in company with Tom O'Neill, Assistant Entomologist for Texas, he made a brief survey of conditions relating to the sweet potato weevil in eastern Texas.

On March 11, Mr. H. G. Crawford, Entomological Branch, attended the spring conference of the Eastern Corn Borer Inspectors, at Toronto, called by Professor L. Caesar, Provincial Entomologist. Work for the year is being undertaken by the inspectors in fine spirit as a result of the general success of the corn borer campaign of 1928.

Mr. A. B. Baird, Entomological Branch, visited Ottawa, February 19–23, to discuss the development of parasite investigations with the Dominion Entomologist and other officers. He reports that, up to the end of February, the number of spin-ups of the corn borer parasite, *Exeristes roborator*, placed in cold storage, at Chatham, has been increased to 40,000.

Mr. Arthur Kelsall, Entomological Branch, Annapolis Royal N. S., reports that they have received a considerable number of twigs from various orchardists in the Annapolis Valley, N. S., infested with eggs of European red mite, apple sucker and budmoth. From an examination of the twigs it appears that the budmoth is considerably less in evidence than in 1928.

W. W. Stanley, of the Agricultural Experiment Station of the University of Tennessee, at Knoxville, called at the National Museum on March 29 to consult bureau specialists. He was especially interested in seeing the collections of cutworms and leaf-cutter bees, and while there obtained a list of references to publications on the habits of the latter.

Mr. C. E. Petch, Entomological Branch, visited Quebec, March 4–7, and Montreal, March 21, to attend conferences in connection with the planning of orchard spray services for the coming season. On March 27, Mr. Petch addressed a Fruit Growers' Short Course, at Morrisburg, Ont., on orchard insects and their control, and experimental work with insecticidal sprays and dusts.

On February 22, J. M. Miller, Bureau of Entomology, visited the nursery of the Eddy Tree-Breeding Station at Placerville, Calif. This station is working on the selection and hybridization of conifers, with the object of developing better strains

of timber producing trees. A pine-shoot moth has been causing considerable damage in the nursery and transplant beds.

The annual meeting of the District Investigative Committee, District 5, Forest Service on February 28 and March 1 at San Francisco, was attended by J. M. Miller, F. P. Keen, and H. L. Person, all of the Bureau of Entomology field laboratory at Palo Alto, Calif. The program of cooperative projects involving forest-insect investigations within the district was reviewed at this meeting.

Dr. Karl Friedericks, of the University of Rostock, met several of the specialists in taxonomy of the bureau on March 25, and in the afternoon was taken by Dr. Chapin to the colony of Zoraptera near Falls Church, Va., which was discovered by the latter sometime ago, and which has been under his continuous observation since.

Temporary appointments as field assistants, Bureau of Entomology, Truck Crop Insect Investigations, have been given H. L. Dees, assigned to duty at Picayune, Miss., J. A. Milbrath and J. F. Bock, assigned to duty at Walla Walla, Wash., D. N. Eagle, at Toppenish, Wash, and B. J. Landis, at Columbus, Ohio. H. C. Mason has been appointed agent, and assigned to duty at Columbus, Ohio.

After attending a meeting of corn borer Inspectors at London, Ont., on March 12, Mr. A. B. Baird, Entomological Branch, proceeded to Arlington, Mass., where he conferred with Mr. D. W. Jones in connection with corn borer parasite work. Mr. Baird returned to Chatham from Arlington with 22,000 cocoons of *Microgaster tibialis* and 3,500 of *Eulimneria crassefmunir*, parasites introduced from France.

Dr. R. T. Cotton, Bureau of Entomology, returned to Washington on March 29 from a trip to Manhattan, Kans., where he conferred with Gilbert A. Schenk regarding the bureau's work on flour-mill insects. While there he visited the entomological department of the Kansas State Agricultural College, and gave an informal talk before the Popenoe Club on some new developments in fumigation.

Prof. G. C. Crampton, of the Massachusetts Agricultural College at Amherst, a well-known authority on insect morphology, called at the National Museum on March 18 to get identifications of some interesting insects from Chile which he expects to use in his morphological work. The fauna of Chile contains some insects of decidedly primitive structure, which Professor Crampton finds unusually interesting and important.

Dr. Charles H Richardson, of the Department of Entomology, Iowa Agricultural College, at Ames, visited the field laboratory, at Webster Groves March 6. Dr. Richardson is conducting research and teaching in insect physiology, and was returning from a conference with Prof. Dean, Dr. O'Kane, Prof. Flint, and others, under the auspices of the Crop Protection Institute, at a chemical manufacturing plant near St. Louis, Mo.

J. E. Patterson, Bureau of Entomology, of the field laboratory at Palo Alto, has been working up the section on forest entomology in the Naturalists' Information Manual for Crater National Park. W. D. Edmonston has completed drawings for illustrating the manual, which will be issued in mimeographed form. This manual is being prepared in collaboration with Ansel Hall, Chief Naturalist for the National Park Service.

Dr. Fenner S. Stickney, Bureau of Entomology, in charge of the field laboratory at Indio, Calif., went to Washington, D. C., to conduct treatments on date-palm offshoots which are being imported by the Bureau of Plant Industry. This work is

being done under the direction of the Plant Quarantine and Control Administration, to which Dr. Stickney has been temporarily assigned until the conclusion of the treatments.

Visitors to the Gipsy-Moth Laboratory, Melrose Highlands in March included Miss E. G. Rice and four of her students at the Brookline, Mass., High School, March 5; G. A. Smith, in charge of moth work, Massachusetts Department of Conservation, and six of his division superintendents, March 7; A. B. Baird, Entomological Branch, Canadian Department of Agriculture, and D. W. Jones, of the Corn-Borer Laboratory, Arlington, Mass., March 13.

Shipments of the egg parasite, *Trichogramma minutum*, were supplied by the Chatham Parasite Laboratory, Ontario, to Mr. D. M. Daniels, of the New York Experiment Station, Fredonia, N. Y., and Mr. J. W. Evans of the Farnham House Laboratory, Farnham Royal, Bucks, England, during March. A shipment of approximately 20,000 eggs of the Angoumois grain moth were forwarded to Mr. D. W. Jones of the Arlington Laboratory, Mass., recently.

The research Council of the California Forest Experiment Station met in San Francisco on February 4, Dr. Ray Lyman Wilbur, President of Stanford University, presiding. The meeting was attended by Messrs. Miller and Person of the field laboratory at Palo Alto, Bureau of Entomology. Mr. Person read a paper on the experimental work in forest entomology which is being carried on in cooperation with the Experiment Station.

Visitors to the Dried Fruit Laboratory at Fresno in February numbered 25, and included Professor W. C. O'Kane, G. J. Morton, E. B. Russell, and W. C. Taber, of the San Francisco office of the Food, Drug and Insecticide Administration, Professors Ralph E. Smith, H. N. Hansen, and I. J. Condit, of the University of California, E. P. Roleson, chemist, California Packing Corporation, and C. E. Scott, Office of Plant Pathology, California State Department of Agriculture.

In February, J. A. Hyslop, Bureau of Entomology, visited the colleges of agriculture of Minnesota, Illinois, Indiana, and Ohio, to study methods of making the insect-pest survey now in vogue at these stations, and in particular the long-established Natural History Survey of Illinois. State insect pest surveys will be organized this year in Minnesota and Ohio, and it is hoped that other States will soon establish similar work.

E. A. McGregor, Bureau of Entomology, has addressed farm bureau center meetings in central California, speaking on the subject of citrus-thrips control., at Visalia on February 25, Orange Cove, March 8, and Lindsay, March 19. On March 20, he attended the quarterly meeting of the state-wide fig clean-up committee of which he is now a member, and read a report on the life history and biology of the Mediterranean fig scale.

Mr. Arthur Gibson, Dominion Entomologist, Entomological Branch, Ottawa, accompanied by Mr. F. A. Herman of the Division of Chemistry, Central Experimental Farm, attended the Sixteenth Annual Meeting of the New Jersey Mosquito Extermination Association, held at Atlantic City, Feb. 13–15, and presented a paper entitled, "Mosquito Suppression Work in Canada in 1928." On the return journey to Ottawa, a visit was made to the Japanese Beetle Laboratory at Moorestown, N. J.

Dr. J. M. Swaine and Mr. J. J. DeGryse, Entomological Branch, visited Quebec, with officials of the Provincial Department and representations of lumbering interests, in relation to the hemlock looper situation on the north shore of the St. Lawrence river. In this region, serious injury to valuable pulpwood areas is threatened by the looper outbreaks and cooperative measures in connection with investigating and controlling the outbreaks were discussed.

On March 7, J. M. Miller and Dr. H. E. Burke, Bureau of Entomology, attended a meeting of the California State Board of Forestry, held in San Francisco, to discuss the allotment of the next biennial appropriation of State funds for cooperating with Federal forest-research agencies. E. I. Kotok, Director of the Forest Experiment Station at Berkeley, and Messrs. Bowie and Gray, of the Weather Bureau, San Francisco, were other officials of the Department of Agriculture who were present.

Arthur Gibson, Dominion Entomologist, and Frank A. Herman, Assistant Chemist, both of Ottawa, Canada, visited the Japanese Beetle laboratory on February 15. Other visitors were C. W. Collins, in charge of gipsy moth research, Gipsy-moth laboratory, Melrose Highlands, Mass., on February 21, C. H. Popenoe, of the Division of Truck-Crop Insects, U. S. Bureau of Entomology, Washington, on February 27, and on other dates Prof. Clyde C. Hamilton, Entomologist, of Rutgers University, and R. Bourdette, of the New Jersey State Experiment Station.

Dr. J. M. Swaine, Entomological Branch, addressed a meeting of the Entomologists' Group of the Professional Institute, on observations of entomological interest made while on a visit to Australia, last summer, to attend the Empire Forestry Conference. Dr. Swaine briefly discussed the climate, flora and fauna, and major entomological problems of the Antipodes, and presented some interesting information on the organization of the entomological services of Australia and New Zealand, and the work which these organizations are accomplishing.

The following members of the Cereal and Forage Insect Division, Bureau of Entomology, attended the meetings of the North Central States Entomologists at East Lansing, Mich., on February 28 and March 1: W. H. Larrimer, D. J. Caffrey, C. M. Packard, George I. Reeves, Philip Luginbill, F. L. Simanton, W. A. Baker, F. F. Dicke, C. H. Batchelder, W. B. Noble, and Curtis Benton. Sessions of the Annual Research Conference of Corn Borer Insecticide Investigators, of which C. H. Batchelder is chairman, were held on February 27 and 28, in connection with these meetings.

A well attended and enjoyable Entomological Branch social was held in the Halycon Club, Ottawa, on Wednesday evening, April 3. The first part of the evening was taken up with an illustrated address by Dr. J. M. Swaine, dealing with his experiences and impressions on a trip to Australia last year. Dr. Swaine's lecture was an extremely interesting one and was greatly appreciated by all those present. After the address, refreshments were served, and the evening's entertainment was concluded with an enjoyable dance.

A. B. Gahan has recently been the recipient of two important shipments of the C. F. Baker collection, including specimens that had been sent by Professor Baker to specialists for study. Dr. G. Grandi, Instituto di Zoologia, R. Universita, Bologna, Italy, sent a number a specimens of fig insects, among which are several types of new species described by him. Dr. L. Masi, Museo Civico di Storia Naturale, Genoa, Italy, returned a portion of the material of the family Chalcididae. Several types of Dr. Masi's new species were included in this consignment.

Mr. H. G. Crawford, Entomological Branch, was absent from Ottawa, January 27–March 5, visiting the various laboratories in Ontario and Western Canada, including Strathroy, Chatham, Saskatoon, Indian Head, Kamloops, Vancouver, Victoria, Agassiz, Vernon, Lethbridge and Winnipeg, in the order named, returning via St. Paul, Minn., where he conferred with Messrs. K. M. King and H. E. Gray. He also spent a day at Lansing, Mich., and attended an interesting and instructive conference of the North Central States Entomologists. Mr. G. M. Stirrett of the Chatham laboratory was present at the conference.

Dr. T. E. Snyder, Bureau of Entomology, returned from Panama on March 26, after inspecting the experiments with wood preservatives being conducted in the Canal Zone. Excellent results are being obtained with brief treatment and the tests have been greatly enlarged. On March 28 a conference was held under the auspices of the National Committee on Wood Utilization, in the Department of Commerce, Washington, D. C., to present preliminary results on the uses of treated woods in the tropics and the latest information on the work being done in termite-proofing buildings.

Perez Simmons, Bureau of Entomology, inaugurated on February 7 a periodical exchange for 1929 among the laboratories of the bureau on the Pacific Coast. Fourteen laboratories are cooperating in the exchange, which includes 441 numbers of 33 periodicals, mostly dealing with entomology or closely related subjects. Among the publications thus made available to each worker are Biological Abstracts, Quarterly Review of Biology, Review of Applied Entomology, and Science News Letter. Those entering magazines in the exchange are Messrs. Blanchard, Campbell, Cole, Doucette, Elmore, Keen, Lane, Larson, McGregor, Newcomer, Rockwood, Shirck, and Simmons.

George H. Harrington, an oil geologist associated with the Standard Oil Company, and who for several years was located in northwestern Argentina, recently called at the National Museum and donated to it a large number of Argentinian and Bolivian beetles which he had collected during the past decade. Many of these were taken by him in the course of geological investigations along the Rio Beni, and consequently are an important supplement to the collection of beetles from the same region made by Dr. W. M. Mann on the Mulford Biological Expedition in 1921 and 1922.

Importations by the Bureau of Entomology of parasites of the European corn borer have progressed satisfactorily in the recent winter. The actual cost per parasite has been much lower than in any previous year, and the parasites are in good condition. Four species which pass the winter in the cocoon total 110,742 in number. The corn-borer larvae shipped this winter from France number 1,244,900, and 122,069 have been received from Japan. From these will be reared at least ten other species of parasites which pass the winter inside the living borers.

On January 7, at the request of a large dried-fruit packing house, W. D. Reed, Bureau of Entomology, was in San Francisco to attend a demonstration of a new experiment for vacuum fumigation, estimated to have cost $20,000. D. B. Mackie, of the California State Department of Agriculture, who is a collaborator of the bureau, and also a representative of business firms, was present. On January 15 to 18, W. D. Reed tested the new fumigating chamber constructed in the San Jose plant of the California Packing Corporation. Liquid hydrocyanic acid, ethylene oxide, and a proprietary fumigant were used.

W. H. Thorpe, of Cambridge University, England, Traveling Fellow in Entomology, visited the Division of Insects several days in the last week of March. While there he examined the specimens in the collection belonging to a small group of predacious flies introduced from Australia into California many years ago, as parasites on the cottony cushion scale. Mr. Thorpe also spent some time with some of the bureau specialists, obtaining identifications and other information regarding various insects. He was taken by Mr. Barber to the field laboratory at Sligo, Md., for consultation with Dr. McIndoo and Mr. Siegler.

Dr. F. C. Craighead and J. A. Beal, Bureau of Entomology, in charge of the field laboratory at Asheville, N. C., spent the first two weeks in March at Starke, Fla., working with members of the Southern Forest Experiment Station of the Forest Service on the interrelation of the turpentine borer (*Buprestis apricans* Hbst.) and turpentining operations. It is believed that fairly satisfactory measures have been worked out which will effectively prevent practically all the damage by the borer. Mr. Beal remained at Starke until the latter part of March to complete observations on the feeding habits and oviposition of this insect.

D. W. Jones, Bureau of Entomology, in charge of the field laboratory at Arlington, Mass., and Dr. C. H. Batchelder, in charge of the chemotropic and insecticide work there, recently conferred with Prof. W. C. O'Kane, of the University of New Hampshire, at Durham, N. H. Since these persons are already in very close contact with the Boyce-Thompson Institute, with Dr. R. C. Roark, of the Insecticide Division, Bureau of Chemistry and Soils, and with Dr. G. H. Adams, of the Bureau of Chemistry and Soils, who is stationed at Boston, very valuable cooperation in the campaign against the European corn borer is being secured.

Four commodious new buildings, with all modern conveniences, especially constructed by local capital to meet the expanding needs of the Bureau of Entomology field laboratory at Tallullah, were completed in March and have been occupied. Two of the buildings provide quarters for the chemical and biological laboratories and the field forces; one is used for an automobile repair shop and storage room for cars and trucks, and one provides storage for insecticides, field equipment and necessary miscellaneous items. They are located 2 miles south of Tallulah, on Number 65 National Highway, and occupy one of the highest and most desirable places in the vicinity of Tallulah.

Mr. Arthur Gibson, Dominion Entomologist, Entomological Branch, visited Fredericton, N. B., on March 22, in connection with the site of the Entomological Branch laboratory. Owing to the present site being required for a new building to be erected on the campus of the University of New Brunswick, the laboratory is being removed to a new location. On March 27, he attended a meeting of federal and provincial officials held at the Plant Pathological laboratory, St. Catharines, Ont. This meeting was called to discuss the various projects under study in the Niagara Peninsula and also for the purpose of establishing closer cooperation between pathological and entomological workers.

In connection with the outbreak of spruce budworm in the Westree district, Ontario, it is planned to carry out extensive airplane dusting experiments during the coming summer. The Royal Canadian Air Force is making arrangements to assign a triple-engine plane, with a capacity for carrying a ton of insecticidal dust, for use in this work. The Ontario Forestry Branch are also cooperating, by providing a camp, and the dust required for the operations. The work at Westree will be commenced

about the middle of May, and it is planned to conduct the dusting operations during the last two weeks of June and in early July.

At the request of the City Engineer's Office, received through J. K. Fisher, of the Bean Weevil laboratory at Modesto, Calif., Dr. H. E. Burke and Albert Wagner, both of the field laboratory, Bureau of Entomology, at Palo Alto, visited Modesto, Calif., March 11 and 12, to investigate and advise on a program of spraying the city shade trees to control several insect pests which have caused considerable trouble in the past. The principal pests found were the European elm scale on elm, the sycamore bark scale, (*Stomacoccus platani* Ferris) and the western sycamore lace bug (*Corythucha confraterna* Gibson on the sycamore, and the hornet moth (*Alcathoe apiformis* Clerck) on poplar.

The Modesto, Calif., *News-Herald* for January 11 and 12 carried several interesting accounts regarding control of the bean weevil in Stanislaus, Merced, and San Joaquin, Counties, and featured illustrations furnished by A. O. Larson and C. K. Fisher, Bureau of Entomology. Fifty ranchers residing in Merced County met at Hilmar on January 14 and unanimously passed a resolution favoring the adoption of a county ordinance providing for the destruction of sources, in storage, of development of the bean weevil. Thanks to the hearty support given by State and county agricultural agents, the principal bean growers of this district are solidly behind the movement to control bean weevils. A resolution was proposed, the object of which was to retain in this district the services of Messrs. Larson and Fisher.

William Middleton, Bureau of Entomology, attended the National Shade Tree conference held at the Brooklyn Botanical Gardens, Brooklyn, N. Y., February 7 and 8. This was the fifth of such conferences and the second following permanent organization. It was very well attended by scientists and commercial shadetree men. A. F. Burgess, formerly of the bureau, and now with the Plant Quarantine and Control Administration, was elected vice-president for the year. Many interesting papers were presented, covering the subjects of case records, callus healing, aeration of tree roots, tree injection, oil-spray problems, fertilization of trees, and a series of papers on both insect pests of trees and fungus growths of trees. H. J. MacAloney prepared a paper on the white pine weevil as a pest of shade trees for presentation at the conference.

G. F. Moznette, Bureau of Entomology, in charge of pecan-insect investigations, attended the meetings of the Cotton States Branch of the American Association of Economic Entomologists held at Houston, Tex., February 6 and 7, where he presented a paper on "Airplane dusting experiments and results secured for the control of the pecan leaf case-bearer." Others present from the Division of Deciduous-Fruit Insects were O. I. Snapp, of the field laboratory at Fort Valley, Ga., and C. C. Pinkney, of that at Brownwood, Tex., Mr. Snapp was elected secretary-treasurer, and B. R. Coad, in charge of the Division of Cotton Insects, chairman, of the Cotton States Branch. After the meetings Mr. Moznette visited the field laboratory at Brownwood, and that at Shreveport, La., and conferred with various men who are working on pecan insects. Mr. Snapp, with several State entomologists, made a trip into the lower Rio Grande Valley of Texas to observe some of the work being done on the Mexican fruit worm and in inspection at points on the Mexican border.

Horticultural Inspection Notes

An amendment to the Nevada alfalfa weevil quarantine has been promulgated by that State, effective March 1, 1929.

Prof. George A. Dean, State Entomologist of Kansas, returned the latter part of April from a trip to the Pacific Coast.

Mr. G. A. Yeaton, State Horticulturist of Maine, passed away in January. He has been succeeded by Mr. Robert F. Chandler, Jr.

Mr. M. C. Rich, formerly in charge of the port of San Ysidro, Calif., returned to active duty on May 1, 1929, after several months' illness.

The State Legislature of Michigan recently repealed the act providing for the quarantine and control of the European corn borer.

The State of California issued Pest Control Regulation No. 3 (Revised), pertaining to the vegetable weevil, effective February 5, 1929.

Messrs. T. H. Burriss and R. T. Kyzar, Agents, who have been assisting temporarily at the port of Nogales, Arizona, resigned April 20 and March 18, respectively.

The Federal Woodgate rust quarantine was amended, effective April 1, to add Madison County, New York, to the area designated as regulated on account of this disease.

Mr. J. M. R. Adams, of the Plant Quarantine and Control Administration, inspected special permit material grown in the States of Virginia, and North and South Carolina during the period March 26 to April 10, 1929.

Mr. E. G. Hagadorn, who has been employed as an inspector of the Plant Quarantine and Control Administration since March 1, 1918, resigned on April 4, 1929.

Mr. William F. Turner has been appointed by the Bureau of Plant Industry of the United States Department of Agriculture to take charge of the phony peach disease eradication operations in Georgia and Alabama.

Mr. E. R. Sasscer, In Charge of Foreign Plant Quarantines, left Washington, D. C., April 15 for the purpose of conferring with the Administration's representatives at some of the southern ports and the Mexican border ports.

Mr. V. C. Durham, who has been serving as a collaborator of the Plant Quarantine and Control Administration since February 1, 1924, was appointed Associate Plant Quarantine Inspector effective April 3, 1929. Mr. Durham will have charge of the Administration's work at Savannah, Ga.

At the meeting of the Southern Plant Board at Houston, Tex., on February 5, the following officers were elected: G. M. Bentley, Chairman; W. E. Anderson, Vice-Chairman; B. P. Livingston, Secretary-Treasurer; Wilmon Newell and R. W. Harned, representatives on the National Plant Board.

Mr. A. C. Hill, who has been in charge of the port of San Ysidro, Calif., resigned to accept a position with a commercial firm on May 6, 1929. Mr. Leroy Schoening, who was formerly employed by the California State Department of Agriculture, has succeeded Mr. Hill as Inspector in Charge at San Ysidro.

A folder giving a map of the European corn borer regulated area, a statement of the principal restrictions of the quarantine on account of that pest, and a request for cooperation in the enforcement of that quarantine, has been prepared for use at road stations on the European corn borer project during the coming summer.

In February the Texas legislature amended the pink bollworm law "providing compensation for all losses incurred or expenses sustained by all persons, firms, or corporations required to comply with the provisions of" the pink bollworm law of 1921 and "providing for State ownership or lease of fumigation and sterilization plants."

Mr. Harry D. Wilson, Commissioner of Agriculture of Louisiana, visited Washington the latter part of April in connection with the farm relief legislation, and while there conferred with the Plant Quarantine and Control Administration on matters relating to preventing the introduction of the Mediterranean fruit fly into Louisiana.

During the last two weeks of April the Mexican fruit worm (*Anastrepha ludens*) was found to have become reestablished at a number of points in the regulated area in that part of southern Texas regulated under Federal Notice of Quarantine No. 64. The host-free period started in this area on March 31 and the fruit in which the larvae were found was in storage.

The Commissioner of Agriculture of Texas in March released part of the northern half of Dawson County from the area regulated to prevent the spread of the pink bollworm. This action is expected to be followed in the immediate future by the release of the same territory under the Federal quarantine. The pink bollworm has never been discovered in the districts now released from restriction.

The State of Pennsylvania has recently issued the following quarantines: Notice of Quarantine No. 20, relative to the Japanese beetle (*Popillia japonica*), effective February 15, 1929; Amendment No. 1 thereto, relating to the Asiatic beetles, effective April 20, 1929; and Notice of Quarantine No. 21, relative to the European corn borer (*Pyrausta nubilalis*), effective March 15, 1929.

The date scale eradication program in which the States of California and Arizona are cooperating with the United States Department of Agriculture, is being expanded, appropriations of $86,700 having been made to the Federal Department of Agriculture; $25,000 to the California State Department of Agriculture, and $10,000 to the Arizona Commission of Agriculture and Horticulture for the year.

The rules and regulations governing the movement of plants and plant products into and out of the District of Columbia were revised effective April 1. The revision, according to the press notice of the Department of Agriculture, made little if any change in the present practice of the Department in certifying nursery and greenhouse stock, but the form and phraseology were modified to conform with several quarantines relating to such articles.

Importers propagating bulbous iris under special permit from the United States Department of Agriculture were advised on March 28 that the cutting of flowers (not foliage) from field plantings of such bulbs would thereafter be permitted. The decision, which was published as Circular PQCA-222, was based on the advice of the horticultural specialists of the Department that the judicious cutting of such flowers from field-grown bulbous iris will not materially reduce the propagation results.

The State of Connecticut recently issued Quarantine Order No. 18, concerning the gipsy moth; Quarantine Order No. 19, concerning the satin moth; Quarantine Order No. 21, concerning the European corn borer; and Quarantine Order No. 20, concerning the Japanese beetle; and Quarantine Order No. 22, concerning the Asiatic beetles. These orders represent revisions of that State's former quarantines

and bring them into conformity with the Federal regulations on account of these pests. The first three named became effective on March 15, and the last two on April 1, 1929.

Mr. L. S. McLaine, Entomological Branch, visited Toronto, Feb., 14–15, to attend meetings of the Ontario Horticultural Association, and interview various importers and provincial officials.

Mr. P. N. Vroom, Entomological Branch, who has been connected with the staff of the Division of Field Crop and Garden Insects at the Vernon laboratory, has been transferred to the Division of Foreign Pests Suppression and will be employed on the headquarters staff at Ottawa.

Mr. C. H. Hadley, in charge of Japanese beetle control, and Mr. O. K. Courtney, who has recently joined Mr. Hadley, visited College Park, Maryland, on April 11, in connection with the Japanese beetle control program in Maryland. While here Mr. Hadley addressed the Entomological Seminar on the status of the Japanese beetle problem.

As a result of the revision of the Canadian nursery regulations, effective September 1, 1928, requiring the re-inspection of all importations of nursery stock from the United States, the headquarters and district inspection staffs have been extremely busy, an extra staff in each district has been necessary. It has been necessary to increase the Entomological Branch inspection staffs at the several ports as follows: Mr. G. L. Giasson, who has been employed with the Branch for several seasons on gypsy moth scouting in Quebec and corn borer parasite work at the Chatham laboratory, has been taken on the Montreal staff; Mr. P. N. Vroom, recently transferred to the headquarters staff of the Division from the Field Crops Division, is now assisting in the Toronto district; Mr. Cyril Copeland, is also assisting in Toronto; Mr. J. C. Paddon is assisting at Niagara Falls; Mr. E. W. Colbert, of London, is assisting Messrs. Thompson and F. J. Hudson at Windsor.

Messrs. R. W. Sheppard, and F. W. Gregory, Entomological Branch, of the Niagara Falls Plant Inspection Office, discovered two European Corn borer larvae, one alive and one dead, in the wrapping paper covering a recent shipment of fern runners, forwarded to Toronto by a firm in Massachusetts. In view of the fact that the larvae probably were of the two-generation strain every precaution was taken by carefully examining the shipment and destroying the packing. The matter was reported to officials in the United States and is being thoroughly investigated.

Under the title "Instructions to Inspectors on the Disinfection of Nursery Products for the Japanese and Asiatic Beetles," the Plant Quarantine and Control Administration on April 16 issued PQCA-224, for the use of Japanese beetle inspectors in the regulated area. The instructions are divided into three main sections relating to "the disinfection of soil in the absence of plants," "disinfection of soil about the roots of plants," and "directions for treating different nursery plants." The last-named section lists separately by scientific and common names those plants which are to be treated by (a) washing the roots; (b) hot water treatment, or (c) carbon disulphide emulsion, respectively.

The Plant Quarantine and Control Administration on April 10 issued an order (PQCA-223) announcing that beginning with the season 1929, importations of narcissus bulbs shall be permitted to a "total of 25,000 bulbs in any one year, this

total to include any number of varieties and permits. The limitation would not apply to the Chinese sacred lily. In the same order it was stated that further permits will be refused for the following varieties: Glory of Sassenheim, Laurens Koster, King Alfred, Paper white; Sir Watkin, Soleil d'Or and Spring Glory, that it would appear that there will be no need after the importing season of 1929 for importations for propagation stock of Gloriosa, Minister Talma, Pheasant's Eye (*Poeticus recurvus*) and Tresserve, and that it is therefore unnecessary to accept the pest risk which would accompany their further entry.

Sixty-four counties of Georgia and one county of Alabama were placed under quarantine by the Secretary of Agriculture on April 30, in order to prevent the spread of the phony peach disease. The quarantine restricts the movement of peach trees, peach roots, nectarine trees, nectarine roots, and all other kinds and varieties of trees and shrubs, grafted or budded on peach and nectarine roots. Permits for such movement are conditioned on the nursery stock having been produced in a nursery within which and within one mile of which no infection of the phony peach disease has existed for at least two years prior to the proposed date of movement. The disease is one which causes dwarfing and reduces productivity of peach and nectarine trees. The infectious virus appears to be confined to the root system and the method of spread inside the orchard is unknown. The disease can readily be transported to new localities on nursery stock.

The Mediterranean fruit fly was found in grapefruit originating at Orlando, Fla., by Mr. J. C. Goodwin on April 6. Adults were secured a few days later and were identified by Mr. C. T. Greene, at the United States National Museum on April 10. The State Plant Board of Florida met on April 15 and as a result of the scouting during the few previous days placed Orange, Seminole and part of Lake Counties under State quarantine. This quarantined area was extended on April 29 and again on May 4 to add parts of Volusia, Brevard, Putnam and Osceola counties. On April 22 a hearing was held at Washington to consider Federal action with reference to the pest and Notice of Quarantine No. 68 was issued on April 26, bringing under Federal regulation as to interstate movement, practically all the fruit and vegetable products of the State of Florida. Dr. C. L. Marlatt, Chief of the Plant Quarantine and Control Administration, spent about a week in April reviewing the situation at first-hand, and left Washington again for the infested territory on May 8. Dr. Wilmon Newell has been placed in charge of the eradication operations for both the Federal Department and the State of Florida. Immediately upon the discovery of the outbreak, the State released an emergency appropriation of $50,000. Shortly thereafter Congress made available $4,250,000 to meet the emergency; the joint resolution for this purpose after passing both Houses was signed by the President on May 2. A number of employees from the pink bollworm and Mexican fruit worm projects have been transferred to Florida to assist in scouting and similar measures and Mr. Foster H. Benjamin of the latter project and G. B. Merrill are making the identifications of the suspected material in the field. Headquarters have been established at Orlando, Fla., where Orange County has turned over to the eradication forces an old court house building which had just been vacated a short time before.

Apiculture Notes

The monthly meeting of the Maryland State Beekeepers' Assocatiion was held on March 30 at the Rennert Hotel, Baltimore, Maryland.

Miss Malitta D. Fischer, of the American Honey Institute, Indianapolis, Indiana, visited the Bee Culture Laboratory of the Bureau of Entomology on April 1 to 3.

R. H. Richmond, Deputy State Apiarist of Colorado, and Professor of Entomology at the Colorado Agricultural College, visited the Intermountain Bee Culture Field Laboratory, at Laramie, Wyo., early in March.

At the winter meeting of the Washington State Beekeepers' Association, Prof. R. L. Webster was elected Secretary-Treasurer. The next annual meeting of the Association will be held at Mt. Vernon, Washington.

A recent amendment to the North Dakota Bee Law prohibits the sale or movement from apiaries within the State of bees, brood, combs or used beekeeping equipment or appliances without a certificate of health from the State Bee Inspector.

Mr. E. R. Root, senior member of the A. I. Root Co., Medina, Ohio, visited the Bee Culture Laboratory of the Bureau of Entomology on April 18th to discuss various beekeeping matters. He has recently made extended studies of beekeeping in California, Mexico and Central America.

The 1930 meeting of the American Honey Producers' League will be held at Milwaukee, Wisconsin. The date is tentatively set for some time during February. Officials of the Milwaukee Association of Commerce and the Wisconsin State Beekeepers' Association are in charge of local arrangements for this meeting.

Mr. W. D. Achord, of Findlay, Ohio, and Fitzpatrick, Alabama, one pf the pioneer breeders of bees in combless packages and a queen-breeder of note, visited the Bee Culture Laboratory of the Bureau of Entomology on April 26th on his way to Ohio, to discuss methods of shipping bees and standardization of combless packages.

At the annual meeting of the American Honey Producers' League held at Sioux City, Iowa, during February, Mr. J. E. Crane of Middlebury, Vermont, was elected to honorary life membership in that Organization. Mr. Crane has been a national figure in American Beekeeping for many years and has taken an active interest in national and state beekeeping.

Dr. Lloyd R. Watson, of Alfred, N. Y., visited the Bee Culture Laboratory on March 25 and 26, to discuss with members of the staff the results of his work last year on the artificial insemination of queenbees. Doctor Watson has devised a number of new and important changes in his technique which are giving much better results than his procedure as last reported.

The Bureau of Chemistry, U. S. Department of Agriculture, has started a study of honey, this being a new project for which the last Congress appropriated $7,500. Studies will be made along three general lines: First, a study of the acids in honey; second, the determination of the diastase content of honey, together with a study of invertase; and third, the utilization of poor grades of honey.

Mr. and Mrs. Clyde Wheeler, commercial beekeepers of Oberlin, Ohio, visited the Bee Culture Laboratory of the Bureau of Entomology on April 2. Mrs. Wheeler

(nee Iona Fowls) was formerly connected with the A. I. Root Co., of Medina, Ohio. Her father was one of the pioneer beekeepers in Ohio. Mr. Wheeler produces high-grade honey and was awarded first prize on comb honey at the Ohio State Fair in 1927.

Mr. W. J. Nolan, Bureau of Entomology, of the Bee Culture Laboratory of the Bureau of Entomology spent a part of March at the Southern States Bee Culture Field Laboratory, Baton Rouge, La., to continue his work on queen-rearing and queen-breeding. The establishment of a sub-laboratory in the South is making it possible to lengthen the active season for a number of research projects which this Division is carrying on.

George H. Rea, of Reynoldsville, Pa., who is establishing an apiary at New Bern, N. C., which will be devoted largely to the production of package bees, visited the Bee Culture Laboratory on March 22. Mr. Rea is particularly interested in the long-distance shipment of package bees, and had a number of suggestions to make with regard to the type of cage and the kind and quantity of food necessary for unusually long shipment of combless packages.

At the last session of the Ohio Legislature, a bill, known as the McClave Bill, giving authority to County Commissioners to appropriate money for the inspection of bees was passed. Undoubtedly before any County Commissioners will appropriate funds it will be necessary for the beekeepers of that county to give data showing the extent of the beekeeping industry in that county together with evidence of the need of more money to be used for the inspection of bees.

Kenneth Hawkins, of the G. B. Lewis Company, Watertown, Wis., consulted with members of the Bee Culture Laboratory on March 13. Mr. Hawkins, through the G. B. Lewis Company, has assisted very materially in furthering a number of projects of the Division of Bee Culture. He was responsible for the recent issue of "Beecause" which is devoted almost entirely to the desirability of bringing about standardization in the package-bee industry, one of the projects now being undertaken at the Southern States Bee Culture Field Laboratory, at Baton Rouge, La.

Under the direction of Prof. H. F. Wilson, at the University of Wisconsin, a special laboratory has been established for the study of honey. They are placing most of their efforts on a study of the causes of spoilage of honey; in connection with this laboratory, they are also building a storage room in which they will have four different ranges of temperature, varying from freezing to 100°F. They are planning to start this season a series of ten samples, one sample to be removed for study in comparison each year during the next ten years.

At the University of Wisconsin, Prof. H. F. Wilson has found that it is more satisfactory to work with bees in a green house during the winter than during the summer period. Students can raise worker brood and queens and carry on various other sorts of experiments with practically perfect control because of the fact that the bees are not able to fly out and bring in anything from the outside. The bees fly out in the cages, but settle back in the hives in the evening, so that there is very little difficulty in losing bees, and individual colonies go through the entire winter very nicely. Prof. H. F. Wilson thinks that this plan can be used very nicely by all of the colleges where space is available.

Dr. A. P. Sturtevant and J. E. Eckert, of the United States Intermountain Bee Culture Field Laboratory, Laramie, Wyo., attended the convention of the Colorado

Honey Producers' Association held in Denver on March 4 and 5. The fact that this was the thirtieth annual convention of this cooperative association deserves special mention. There are perhaps few organizations which are cooperatively handling agricultural products in this country which can boast of such a successful record. Without doubt one of the reasons for the long and successful existence of this organization has been the congenial personality and business-like character of Mr. Frank Rauchfuss, of Denver, who has been its secretary and manager for the entire period.

Mr. Richard B. Gregg, of Chestnut Hill, Mass., formerly of Simla Hills, India, was a recent visitor at the Bee Culture Laboratory of the Bureau of Entomology. He succeeded in the difficult task of importing Italian bees from England into India. Since his return from India, however, he has received word that predatory wasps or hornets, a serious pest to bees in India, have destroyed these bees. Mr. Gregg mentioned that the production of honey in India is very small because the native hive bee, *Apis indica*, stores only a few pounds of honey per colony, and in order to increase the production of honey he is anxious to introduce the Italian bee *Apis mellifica*.

April 5–6, the Texas Beekeepers Association held its regular Spring Meeting in San Antonio. A very representative group of beekeepers were present. There were also present, Dr. F. L. Thomas, S. E. McGregor of the Inspection Service and Dr. S. W. Bilsing of the teaching force of A. & M. College, A. H. Alex and H. B. Parks of the State Apiculture Laboratory, and Ivan Schillar of the Federal Horticultural Board, noted as a beekeeper and discoverer of the first pink boll worm in Texas. The address of welcome to the beekeepers was made by Fred Malley, Agricultural Agent of Bexar Co., and well known in entomological literature since 1890. Dr. C. S. Phillips who first introduced sweet clover into Texas and Dr. E. P. Stiles who many years ago published several important lists of Texas insects, were visitors.

During this meeting Dr. S. W. Bilsing stated that he had been connected with the Entomology Department of A. & M. College of Texas for sixteen years, a little over three thousand students had passed through his classes and every one of these had received varying amounts of instruction in beekeeping.

Notes on Medical Entomology

T. E. McNeel, Bureau of Entomology, has been transferred from Mound, La., to Zellwood, Fla., for temporary work on the mosquitoes there.

Dr. L. O. Howard, Bureau of Entomology, addressed the New Jersey Mosquito Extermination Association at Atlantic City, N. J., February 13, presenting his annual summary of world-wide mosquito work.

R. W. Wells, Bureau of Entomology, left Washington, February 8, for Galesburg, Ill., to make observations near there on seasonal abundance and stages of development of the cattle grubs.

H. S. Peters, Bureau of Entomology, left Dallas Tex., February 3, by automobile for Terre Haute, Ind., and arrived there February 7, after making observations on cattle grubs en route. After making stops in Columbus, Ohio, and Pittsburgh, Pa., he returned on February 17 to the field laboratory at Beltsville, Md., to which he is now assigned.

F. C. Bishopp, Bureau of Entomology, spent the latter half of March in travel through Florida, Georgia, and the Carolinas, making observations and gathering information concerning mosquitoes, sand flies, and ticks. He attended an anti-mosquito meeting at Ft. Pierce, Fla., March 19 and 20.

W. G. Bruce, Bureau of Entomology, assigned to the Fargo, N. D., field laboratory, arrived there February 13 and took up his duties. The district, in the Red River Valley of the North, where this laboratory is located is free from cattle grubs, although grubby cattle have on various occasions been shipped in. Mr. Bruce's problem is to determine what the factors are which apparently prevent the establishment of Hypoderma there, and his work is being done in cooperation with the North Dakota Agricultural College. Prof. J. A. Munro, of the Department of Entomology, Prof. J. E. Chapman, Department of Agronomy, Dr. A. F. Schalk, Department of Veterinary Science, and Prof. J. H. Sheppard, Department of Animal Husbandry, and others, of the staff of the North Dakota Agricultural Experiment Station, have shown great interest in the problem.

F. C. Bishopp, Bureau of Entomology, left Washington February 8, to make observations at various points on cattle grubs and to supervise the work of assistants in the field. His first stop was Terre Haute, Ind., from there he drove overland to Galesburg, Ill., stopping en route at Urbana on February 11 for a conference with Doctors Flint, Metcalf, and Graham, of the staff of the Illinois Agricultural Experiment Station. On this date, at the request of Dr. Graham, he gave a talk before the Illinois Veterinary Conference, which was in session. Other points visited by him were St. Paul, Minn., Fargo, N. D., and Lamar, Colo. At the place last named conferences were held with officials of the Bureau of Animal Industry who are conducting there an experiment in control of the cattle grub. Mr. Bishopp returned to Washington February 22.